

SCIENCE.

FRIDAY, JULY 20, 1883.

THE U. S. NATIONAL MUSEUM.

I.

THE brief pamphlet recently issued by the assistant director of the museum as his special report for 1881 is, perhaps, one of the most important documents which has yet appeared in the history of science in this country. It represents the institution which in the natural course of events should become the leading organization of its kind on this continent, and also furnish the motive and the pattern for the many similar copies which will naturally follow its example in other parts of our extensive possessions. It also presents to foreign nations the ideals, which, they will naturally suppose, represent our existing scientific culture and the tendencies of science in this country. They will hardly imagine that it has not been debated at all by scientific men at large, that it is the work of no representative commission, and that it cannot in any sense be considered as the deliberate result of consultation with the leading men of the United States in all departments.

In this respect, we think that the action of the government—if the plan is, as we understand, already adopted in the museum—is open to the severest criticism, and that it shows a curious want of prudence to definitely settle the future of an institution in which the whole country is more deeply interested than any other of its kind, without allowing the voice and criticisms of scientific men to be heard. It is certainly a wide departure from the wise example of the Smithsonian, and shows, that, at Washington, success has already begun to dull the edge of the wise forethought which led to such successful results in the planning of that institution.

That the museum must be a loser in influence by such a proceeding lies in the nature

of things. The science of this country is certainly not responsible for the plan, and, however good it may prove to be, has had no proper opportunities for expressing its opinion about a matter in which its deepest interests are concerned.

In his opening considerations, Mr. Goode divides museums into three classes,—those for record, those for research, and those for education. He considers that all three of these objects are essential to the development of any comprehensive and philosophically organized museum. By record, the author means the preservation of collections which have served as the instruments of past research; and by research, the accumulation of materials of all kinds to provide for new investigations. The author here assumes an historical standard, and thinks that the objects of museum administration determine their classification; whereas, in our opinion, practical considerations really settle the class to which a given museum should be referred. There is, as the author remarks, no separation of the two purposes of record and research; and it would perhaps have been clearer to the inexperienced in this branch of technology if the preservation of records, and accumulation of materials for research, together with adequate provision for the publication of original results, which is not mentioned by him, had been defined as the inseparable trinity of a museum of the first class. Mr. Goode's opinion, that such museums should have exhibition-rooms, and display both their records and the results of research, indicates a broad and well-balanced judgment of the aims of museum administration. The prevalent opinion among young investigators, that no public display of records should be made, arises from obstacles which the expenses of exhibition have heretofore presented to the successful performance of the proper functions of this class of museums in the encouragement of research, and also to

their frequent failures as instruments for the education of the public.

Two functions, that of museums of research and that of museums of education, have been confused in their display of specimens; but, while this shows the necessity of a separation and a change of policy in their choice of collections for exhibition, it does not justify the withdrawal of valuable and useful records from public view. Leave to consult original specimens cannot be lightly granted, and the idiosyncrasies of their guardians is a large element of uncertainty in the way of those desiring to see such treasures. There are also classes of persons daily on the increase who should, at any rate, have the privilege of seeing them, though not fit to be trusted with their direct handling; and the wants of this class cannot be justly disregarded. We are therefore most heartily in sympathy with Mr. Goode in his opinion, that the highest value of original records is given to them when they are placed on exhibition; but we probably differ in thinking that this should be done in museums or collections exclusively devoted to research, and meant for the use of the special student rather than the general public.

Mr. Goode's third class of museums, the educational, we should designate as the second class; since these are often separated from the former, and ought always to be conducted with distinct purposes, and governed by a class of men who are familiar with the educational wants of the public, i.e., all those classes of persons who must get their information through the glass, and are not permitted to handle specimens. The needs of this class are but imperfectly understood by the investigator, or, if understood, very apt to be considered by him as of slight importance. It is certainly not his essential function to satisfy these demands, as in the case of the true educator, and as should be the case with the curator of an educational collection.

Mr. Goode's ideal of a great educational museum is accomplished by the union of the natural history and industrial museums; and this has evidently arisen from his experience and

study of similar unions occurring more or less accidentally in the different great exhibitions held in civilized countries of late years. He points out, that, while these great industrial exhibitions have shown a tendency to become purely commercial, they have served, wherever they have been held, as the starting-points, in time and materials, of permanent industrial museums. The effect of the world's fair in Philadelphia in 1876, in accordance with this law, demonstrated the educational value of a more permanent industrial museum, and suggested that an immense field of usefulness would be open to an institution which should be based upon similar grounds, but which would endeavor, by a more efficient and scientific arrangement of its specimens, to impart "a consistent and systematic idea of the resources of the world and of human achievement."

This novel and somewhat startling aim is announced as the future guiding-star of the National museum, which is declared to be in the best possible trim for the accomplishment of such a purpose, since it is now starting anew, and is not encumbered by the immense masses of duplicates which have become the most serious obstacles in the path of the older museums. It is, in other words, free to choose the path of its future work; and while this seems to be true, and the author must be acknowledged the best judge of the fact, we do not find any allusion to the accumulations formerly stored in the Smithsonian, nor as to how these and other collections, made upon the old basis for purely scientific research, are to be brought into harmony with the new ideal.¹ It is much to be regretted, that, in this preliminary announcement of so important a national enterprise, the author had not taken more space for such interesting explanations, and also for the fuller consideration of the arrangement of topics according to their relative importance.

This treatise shows, nevertheless, in all its

¹ Though we do find (as quoted in italics immediately below) that these collections, and we presume those which will be continually flowing in from the Geological survey, the Fish-commission, and other sources, are to be arranged on a different plan from all the other collections. It would have greatly enlightened us if we could have known what this plan was, but nothing further is said of it.

parts, that the practical aspects and difficulties of the question have been studied with great thoroughness and ability, and have naturally absorbed the time and thoughts of the author, and taken, therefore, the most prominent place.

What seem to us the most valuable and fundamental of all the considerations are brought in as secondary. Thus we find an intimation only that the museum "attempts to show the evolution of civilization;" we cannot be wrong, it appears to us, in imagining that this is to be the great aim of the National museum; and again, "the collections should form a museum of anthropology, the word 'anthropology' being applied in its most comprehensive sense. It should exhibit the physical characteristics, the history, the manners (past and present) of all peoples (civilized and savage), and should illustrate human culture and industry in all its phases. The earth, its physical structure and its products, is to be exhibited with special reference to its adaptation for use by man and its resources for his future needs. *The so-called natural history collections—that is to say, the collections in pure zoölogy, geology, and botany—should be grouped in separate series, which, though arranged on another plan, shall illustrate and supplement the collections in industrial and economic natural history.*" We felt immediately the deepest interest in knowing how so large a part of the National museum could be arranged on another plan without confusing the effect of the whole, but looked for explanations in vain.

The idea of making the National museum a museum of anthropology must, we think, command unqualified respect; and it seems to us to contain so much of future promise, that we feel all the more regret that the details of the scheme had not received the healthy purgation of general and expert criticism. The classification is also highly original, and shows the result of extensive study, and practical knowledge of ways and methods.

The general outlines of the scheme of classification, which is announced as provisional and open to necessary modification, are as

follows: the exhibition of articles is to be divided into eight large divisions, or 'sections,' including sixty-four smaller divisions; which last we shall, for convenience, designate under the name of 'topics,' to distinguish them from the sections into which they are grouped by Mr. Goode,—"Section I., Mankind; II., The earth as man's abode; III., Natural resources; IV., The exploitative industries; V., The elaborative industries; VI., Ultimate products and their utilization; VII., Social relations of mankind; VIII., Intellectual occupations of mankind."

We recognize the enormous difficulties in the way of the author of this scheme; and, while we congratulate him upon the successful handling of the details,—which we have not the space to quote in full, and therefore cannot do him personally full justice,—we must dissent strongly from the main ideas, which, we think, show the want of a broad and masterly comprehension of the philosophical ideas which should govern the classification and purposes of our National museum. The scheme itself, in this respect, is a curious mixture of the old notion, that, in order to understand man, we must necessarily start with the study of mankind, and of the modern idea of evolution. The legitimate process of instruction from this stand-point begins with the simplest forms of life, and follows up their developmental and evolutionary history in organization and in time, until we arrive at the most highly specialized forms. Man is the most highly specialized of all animals, physically and psychologically, and therefore, it is claimed, needs to be viewed in the light of all knowledge, unobscured by the prejudices and misconceptions which are liable to arise from the adoption of the opposite modes of study.

Certainly the former mode is incompatible with the thorough and direct method of studying the principles of evolution, whether these relate to one set of objects or another, and is not accordant with the idea of the 'evolution of civilization' and the evident necessity of expressing, in all the minor industrial collections, "the steps by which man has ar-

rived at the present condition in every direction in which human industry has been exerted, — a graphic history of the development of the human culture and civilization.”

These are Mr. Goode's own declarations of what seem to be the vital intentions of his scheme; and it is therefore a serious error, both practically and theoretically, when he places the natural history of man, including his psychology and individual manifestations, at the head of his scheme, in place of making this department the terminal one, to be viewed by visitors only after they had gone through with all the other departments.

The author has arranged the sections and sixty-four topics according to a system which is artificial, and irreconcilable with his intentions and his general objects, and shows this

in the place assigned to mankind. Man is essentially the product of the forces which have acted upon this earth. Without going into the question of whether these forces were divine or material, which is of no value in such a technical discussion, it is certainly very illogical to place the conclusion before the beginning, the consequent before the antecedent, man before the earth. This may be very satisfactory to those who need, or think they need, to perpetually swing the censer before the old idol of man's supremacy in the universe; but it is none the less unnatural and illogical to have one mode of arrangement for the parts of a great collection, and another for the whole.

In a future number we shall consider some of the minor features of this elaborate scheme.

LIST OF TWENTY-THREE NEW DOUBLE STARS, DISCOVERED AT CAROLINE ISLAND, SOUTH PACIFIC OCEAN, BETWEEN APRIL 27 AND MAY 7, 1883, BY E. S. HOLDEN AND C. S. HASTINGS.

Star.	α , 1880.0.			δ , 1880.0.	p.	s.	Mags.	Observer.	Date.
	<i>h.</i>	<i>m.</i>	<i>s.</i>						
Stone, 5791	10	28	35	—54° 46'	250°	2"	8.5 - 9	Holden . .	May 1.
Anon.	11	31	28	—60 14	350	1½	8.5 - 9.5	Holden . .	April 28.
Lac., 4936	11	48	58	—55 25	230	2	7.5 - 8	Holden . .	May 1.
Anon.	11	57	40	—57 5	240	1½	8.5 - 9.5	Holden . .	May 4.
Lac., 5223	12	31	24	—55 16	205	1½	7.3 - 9.3	Holden . .	May 1.
Anon.	13	1	16	—52 5	200	1½	9.5 - 9.5	Holden . .	May 4.
Lac., 5434	13	6	59	—62 57	40	1½	7.5 - 10	Holden . .	May 6.
Lac., 5738	13	48	28	—53 33	330	2	6.5 - 8.5	Russell . .	A. B. }
					290	25	6.5 - 13	Holden . .	May 2, A. C. }
Lac., 5817	13	59	56	—49 18	30	3	7.5 - 7.5	Hastings . .	May 1.
Lac., 5844	14	6	14	—61 9	180	3½	7 - 9	Hastings . .	May 2.
Lac., 6066	14	41	16	—72 42	90	1½	6 - 8	Hastings . .	May 2.
Lac., 6136	14	50	35	—67 30	0	5	7 - 10	Hastings . .	April 27.
Anon.	15	2	18	—40 31	70	4	7 - 8	Hastings . .	May 4.
Stone, 8250	15	3	33	—51 38	220	3	7.5 - 9	Holden . .	May 2.
Lac., 6259	15	6	36	—60 27	300	12	6.5 - 13	Hastings . .	April 27.
Anon.	15	7	20	—68 8	0	1½	7.5 - 9	Hastings . .	May 2.
Anon.	15	8	40	—53 50	170	3	8 - 10	Hastings . .	May 1.
Stone, 8348	15	14	18	—47 29	225	1½	8.0 - 8.5	Hastings . .	May 1.
€ Lupi	15	14	32	—44 15	175	3½	3 - 6	Hastings . .	April 27.
Lac., 6488	15	36	11	—50 24	210	2	7 - 9	Holden . .	May 4.
Lac., 6540	15	44	44	—60 23	85	1	6.5 - 9	Hastings . .	May 2.
Stone, 9221	16	50	15	—56 25	125	2	7.5 - 10	Holden . .	May 7.
Lac., 7315	17	23	16	—40 57	95	1	8.0 - 8.5	Holden . .	May 7.

*THE UNITED STATES FISH-COMMISSION STEAMER ALBATROSS.*¹—II.

The fitting-up of a small floating scientific laboratory, which might remain at sea for a month or more at a time, and yet include every necessary convenience, was a somewhat novel problem, and required a considerable

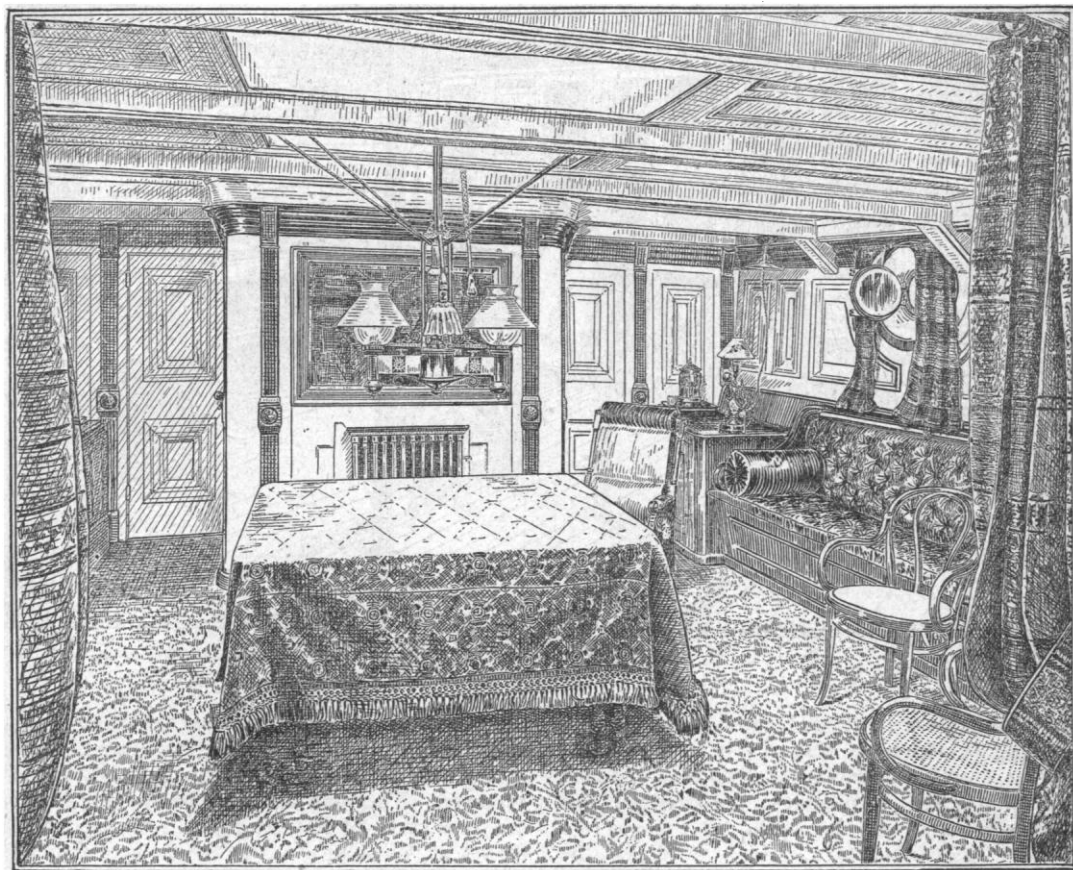
amount of planning, based mainly upon past experiences of the fish-commission. The general arrangements are now, for the most part, complete, but they are subject to alteration and improvement.

The main laboratory (see figures, pp. 68, 69) is twenty feet long, twenty-six feet wide, and nearly eight feet high. The forward-end of the room is devoted to storage, and the sides and

¹ Concluded from No. 22.

after-end to work-tables. The storage-case consists of a series of six double racks, with wire doors in front for holding the trays of bottles and jars, the trays being all of the same size, so as to fit any part of the case. Under the racks are six large bins for the tanks of alcohol in use, the large fish-pans, dishes, and other heavy laboratory utensils, and at either side is a small case for chemicals and preserva-

as the general laboratory, though of less height, and is entirely fitted up for the storage of jars, bottles, tanks, alcohol, zoölogical specimens, and the lighter kinds of collecting apparatus. A single series of bins on a level with the floor extends around the entire room, excepting in front of the stairway, and serves as compartments for the copper tanks of alcohol, which are contained in uniform-sized boxes. In these

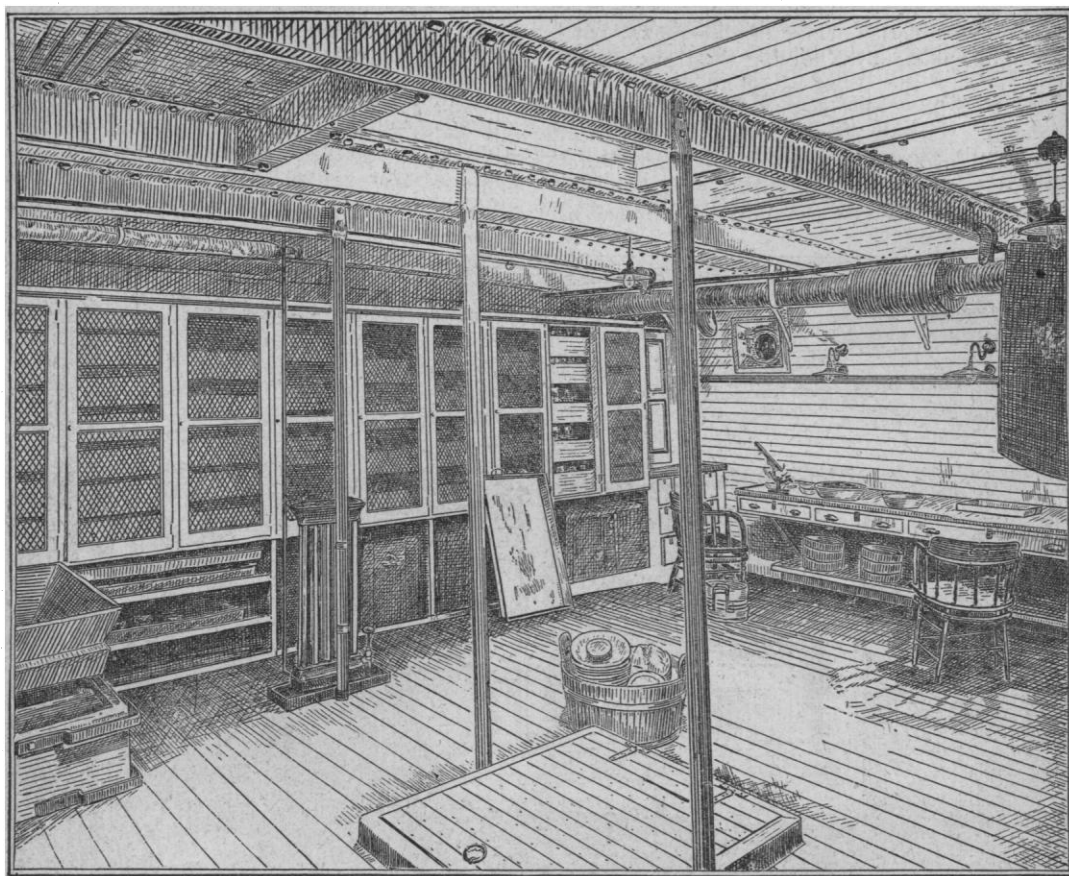


CAPTAIN'S CABIN.

tives. In one of the after-corners is a photographic dark room, and opposite to it the sink and water-supply. The remainder of the space on each side is occupied by a sorting-table, one being at the proper height to work while standing, the other while sitting. The after-bulkhead contains the arrangements for chemical and physical investigations, consisting of a broad table, with drawers and cupboards underneath, and racks above.

The storeroom is of about the same size

bins there is room for fifty tank-boxes, each with a capacity of sixteen gallons, making a total of eight hundred gallons of alcohol which it is possible to carry in this way. Against the fore and after bulkheads, above the bins, are two sets of racks for bottle-trays, similar to those in the general laboratory. They are intended for the storage of the main supply of bottles and jars; and, as rapidly as those in the laboratory become filled with specimens, they are carried below, and their places supplied



MAIN LABORATORY, FORWARD-END.

with empty ones, without the necessity of removing any from the trays. On the two sides of the storeroom are large, deep bins for nets and other light appliances, the dredges and trawls being stored elsewhere.

The deck-laboratory, which receives the greatest amount of light, is more especially arranged for study. The after-end is occupied by a bookcase, with a cupboard for the physical apparatus on one side; and the forward-end, by the medical case, and stairway to the lower laboratory. A large square table, with accommodations for four persons, stands in the centre of the room, under the skylight. Under one window is the sink, and beside it two upright cylindrical tanks for sea-water and alcohol which empty by means of faucets. The other window-spaces are supplied with folding tables, which, when not in use, can be shut down against the wall. Arrangements

are yet to be made in this room for small working-aquaria, where the living forms and colors of delicate marine animals can be studied and pictured. They will probably be modelled after the new style of hatching-jars, recently introduced at Washington, for the propagation of shad and salmon.

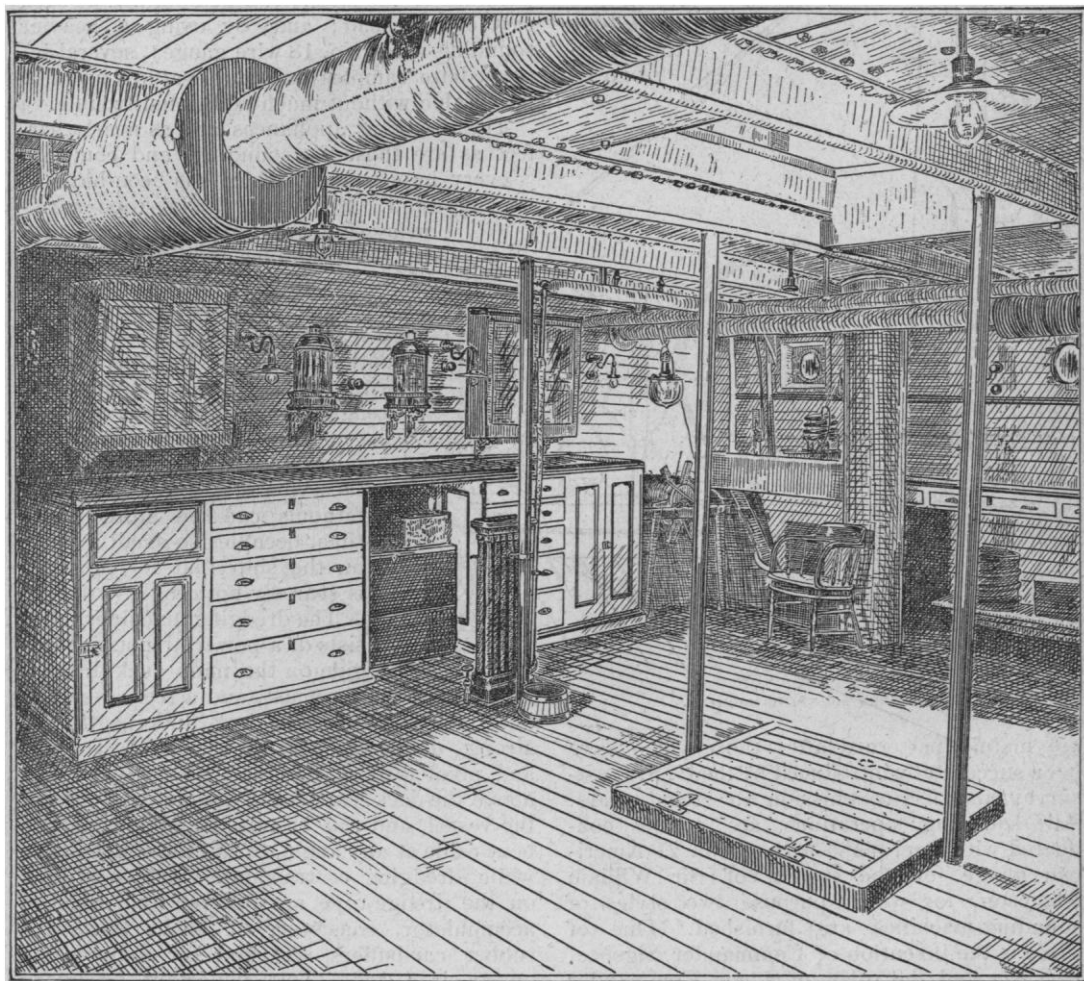
The Albatross is furnished with two propeller-screws instead of the usual number, one, to enable her to execute more readily the various manoeuvres demanded by the peculiar character of her work. They are right and left handed, — one being placed under each counter, — and measure nine feet in diameter. By their means the steamer can be turned completely around almost within her own length, and placed in position for dredging and sounding without the delays incidental to most exploring steamers. The motive power is furnished by two compound engines, with

two cylinders each, — one of high, the other of low pressure, — the stroke of piston being thirty inches. The engines are slightly inclined, the upper ends of the cylinders being drawn inboard over the condenser, which is common to both engines, and forms their framing. The boilers are two in number, of the overhead return-flue pattern, and measure twenty-one feet and a half in length by eight feet and a half in diameter.

The proper ventilation of all parts of the ship was carefully considered during her construction, and the plan adopted has given the greatest satisfaction. It consists simply in withdrawing the foul air from the lower parts of each room through small ventilators, by means of a Sturtevant exhaust-fan with Wise's

steam-motor attachment. The influx of air is from above, through open doors or ports; and a constant circulation is maintained, even in the lowest inhabited portions of the ship.

One of the most interesting features of the Albatross is the system of electric lighting, which has already been referred to. Some such method of replacing the dingy lamps common to most ocean vessels was rendered imperative from the fact that this steamer is supposed to continue her observations as regularly through the night as through the day, and the surrounding surface of the sea must also be lighted. To accomplish this, a hundred and twenty eight-candle B lamps of the Edison incandescent system are distributed through the ship; every portion, including the

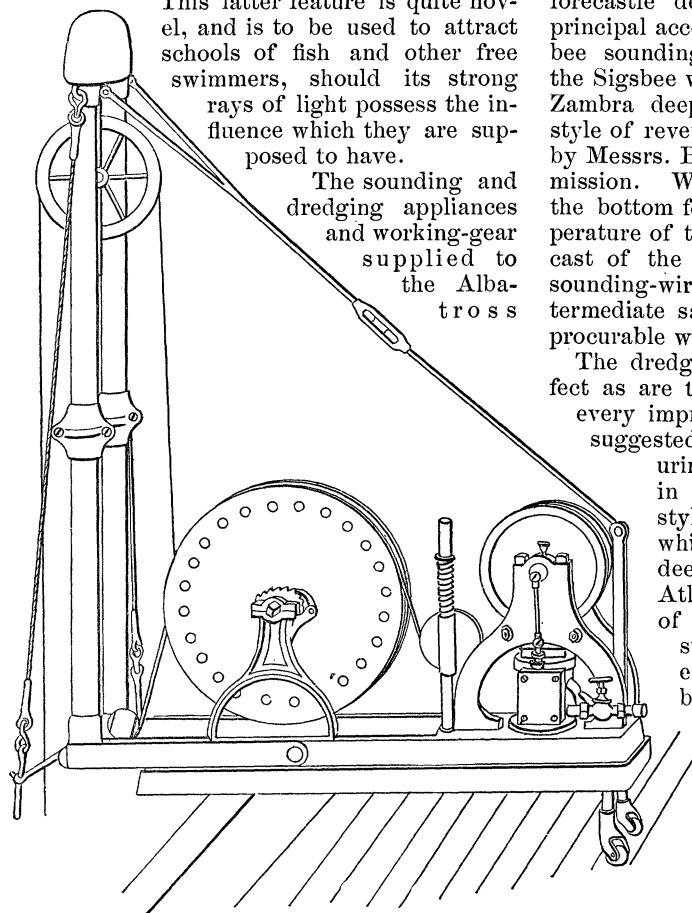


MAIN LABORATORY, AFTER END.

holds, storerooms, and open decks, having its share. They are controlled by a Z dynamo, driven by an Armington and Sim's high-speed engine. An arc-lamp of great power, designed by Dr. O. A. Moses, and intended for illuminating the surface of the water, works in circuit with the same system; and there is also a powerful submarine lamp which can be lowered to any depth not exceeding a thousand feet.

This latter feature is quite novel, and is to be used to attract schools of fish and other free swimmers, should its strong rays of light possess the influence which they are supposed to have.

The sounding and dredging appliances and working-gear supplied to the *Albatross*



THE SIGSBEE SOUNDING-MACHINE.

are mainly patterned after those which have been successfully introduced by the U. S. coast-survey and fish-commission in recent years. All sounding operations are to be conducted with steel piano-wire of No. 21 American gauge, on the system of Sir William Thomson, for which purpose two styles of sounding-machines are furnished. One of these is the invention of Commander Sigsbee, U.S.N., and the other of Lieut.-Commander Tanner, U.S.N. The Tanner machine, in

which the reeling-in is accomplished by hand, is extremely simple in its workings, and is intended for moderate depths of water only. It is attached to the rail on the port side of the main deck, forward of the pilot-house. The Sigsbee machine can be used in all depths of water, down to the deepest parts of the ocean, and is worked by steam. It occupies a prominent position on the port side of the top-gallant fore-castle deck (see opposite page). The principal accessories to sounding are the Sigsbee sounding-rod, with detachable weights; the Sigsbee water-cup; and the Negretti and Zambra deep-sea thermometer, with a new style of reversible metal case recently devised by Messrs. Bailie and Tanner of the fish-commission. With these appliances, samples of the bottom formation and water, and the temperature of the latter, can be obtained at each cast of the lead; and, by using a heavier sounding-wire (No. 18 wire gauge), several intermediate samples and temperatures are also procurable without much additional trouble.

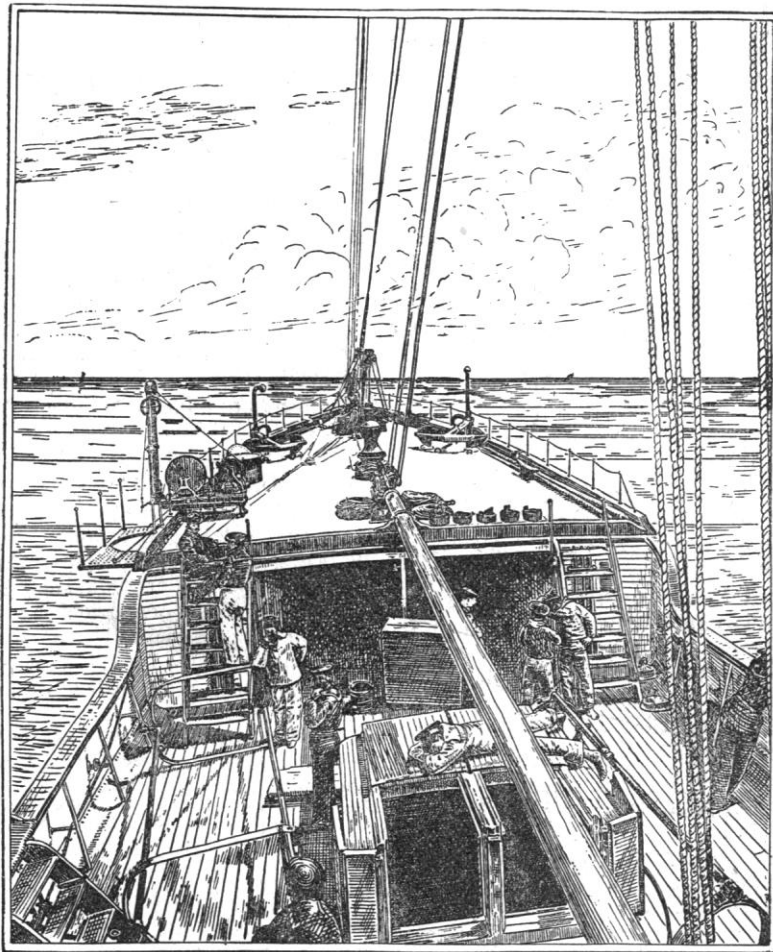
The dredging appliances are as nearly perfect as are those for sounding, and comprise every improvement which has been hitherto suggested. Steel-wire dredge-rope measuring only an inch and an eighth in circumference replaces the old style of three-inch hempen rope, which is no longer recognized by deep-sea dredgers on this side of the Atlantic. The principal advantages of wire rope are its compactness, strength, and durability, and the ease and speed with which it can be handled. The working-reel of the *Albatross*, on which 4,000 fathoms can be stored at a time, occupies so small a space on the ship that its presence is scarcely noticeable.

The dredging machinery consists of a powerful hoisting-engine on the main deck directly in front of the foremast, and a reeling-engine and reel on the berth-deck underneath. A strong dredging-boom, thirty-six feet long, and pivoted to the foremast about seven feet above the deck, carries the dredge-rope clear of the vessel, and can be raised and lowered, or bent aside at any angle, to suit the convenience while dredging or trawling. Sudden strains on the dredge-rope are relieved by a Sigsbee accumulator, consisting of about thirty-five rubber car-buffers arranged for compression on an iron rod. This important accessory hangs suspended from the masthead above the

hoisting-machine. The course taken by the dredge-rope while in use is as follows: starting from the reel on which it is contained, it passes through a pulley on the berth-deck to the drum of the hoisting-engine, thence up to and through an iron block at the lower end of the accumulator, and down again through a sheave in the heel of the boom, from which it

and six thousand pounds, which is less than the tensile strength of the rope they are intended to secure from breakage. The amount of rope out at all times is recorded by a register attached to the sheave in the heel of the boom, the sheave measuring just half a fathom in circumference.

In preparing for work, the dredging-boom is topped up at the requisite angle over the



FORWARD DECK.

extends to the outer end of the boom, where there is another large pulley. The free end of the rope is spliced into the eye of a set of safety-hooks, to which the dredge or trawl is fastened, and which are so arranged as to open and release the apparatus, should the strain, by reason of fouling on the bottom, exceed a certain amount. These hooks can be adjusted to detach at any point between three thousand

starboard bow, and the loaded dredge or trawl is hoisted above the deck, on which stands the sieve or tubs ready to receive its contents. Two methods of sifting or washing the materials are followed. For the trawls, which generally bring up a heavy load, a large and deep, square sieve, standing upon legs at a convenient height for working, is used. As the tail of the trawl is lifted above the deck,

the sieve is shoved under it, and the contents of the former are released. In case no washing is necessary, the specimens are rapidly transferred to their proper receptacles; but if, as usually happens, the load consists mainly of mud or sand, a stream of water from a hose is turned upon it, and it is thoroughly washed down. A nest of three or four small circular sieves, each having a different mesh, is generally employed for washing the contents of the dredges.

To describe the various appliances of research belonging to the outfit of the Albatross would carry us beyond the proper limits of this article: suffice it to say, that every method of obtaining results known to the fishermen and marine zoölogist will be tried. The scientific apparatus is mainly such as has already been thoroughly tested by American expeditions, and much of it has been described in published reports. There are many additional features, however, which have been lately added. The fisherman's outfit is complete, and comprises all kinds of seines and gill-nets, line-trawls, and hooks and line. The principal appliances for deep-sea research will be the dredges and beam-trawls, both in their original and modified forms; and, in connection with the latter, two large towing-nets will always be used. They are fastened, one at either side of the trawl, in the shape of wings, which name they now bear in the dredger's vocabulary. They were introduced as an experiment two years ago by the fish-commission; and, proving an invaluable adjunct to the trawl, they soon became a permanent fixture. The simple open towing-nets are to skim the surface of the sea at all times, when the speed of the vessel will permit; and occasional trials will be made with the Sigsbee trap for ascertaining the amount of animal life within any prescribed area below the surface.

The chemical department has not yet been completely furnished, but all the more important apparatus for making the principal tests, and glassware for saving water-samples, have been supplied. The photographic section has, however, been placed in perfect running-order, and affords the means of illustrating all sorts of objects, whether large or microscopic. It also contains improved appliances for registering the intensity of light at different depths.

Among the small boats with which the Albatross is liberally provided are two steam launches of the Herreschoff pattern for use in setting and hauling nets, and in spearing porpoises and large fish which cannot be reached from the high deck of the steamer.

From the above brief account, it may be rightly assumed that this new addition to our coast-marine is the most perfect floating workshop and laboratory for scientific purposes ever constructed. Its first cruise, during which it encountered severe winds, gave proof of its superior sailing qualities; and, judging of its outfit from past experiences, we are justified in predicting for it a long life of usefulness to science and the fishing interests. RICHARD RATHBUN.

SUN-SPOT OBSERVATIONS.

THE U. S. signal-service has published month by month since June, 1877, observations of sun-spots, made by Prof. D. P. Todd (now of Amherst college) with a telescope less than three inches aperture.

As a maximum of solar spottedness seems to have passed, it has been thought wise to collate these observations in the accompanying table, and present them for comparison and study.

In this table the Roman figures are the actual observed values, and interpolated values in *Italic* type are added for the sake of completeness.

The observations for August, 1878, were made by the Signal-service at Fort Whipple, Va. The mean monthly results combine both actual and interpolated values, and show that the last minimum epoch was at 1878.9, and the last maximum was at 1882.4.

Professor Fritz of Zurich gives the following table of maxima and minima of sun-spots for the present century to 1878. These agree in the main with the results of other researches.

Epochs of maximum and minimum sun-spots of the nineteenth century.

Maximum.	Period.	Minimum.	Period.
1804.2 . . .	12.2	1810.6 . . .	12.7
1816.4 . . .	13.5	1823.3 . . .	10.6
1829.9 . . .	7.3	1833.9 . . .	9.6
1837.2 . . .	10.9	1843.5 . . .	12.5
1848.1 . . .	12.0	1856.0 . . .	11.2
1860.1 . . .	10.5	1867.2 . . .	11.7
1870.8 . . .	11.8	1878.9 . . .	
1882.4 . . .			
Mean . . .	11.2	Mean . . .	11.4

Taking the mean of each twelve months, we have mean yearly numbers, in 1878, 2.2; 1879, 2.0; 1880, 14.3; 1881, 26.7; and, in 1882, 28.3. The last two agree with the observations of Tacchini in Rome.

Prof. D. P. Todd's sun-spot observations.

Day of month.		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Mean daily observation.	No. of days.	
1877.																																			
June		0	0	0	0	0	1	1	2	4	7	13	5	0	0	0	0	0	0	0	0	0	0	0	0	2	5	6	0	0	2	2	1.7	13	
July		4	3	3	3	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	1	2	3	.9	20	
August		4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	4	8	0	0	0	0	2	2	1	1.8	19	
September		0	0	0	0	1	2	4	6	9	10	7	6	4	6	5	12	14	18	10	6	10	5	0	0	0	0	0	0	1	2	30	5.1	16	
October		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2.1	12		
November		30	25	20	12	8	2	0	0	0	0	0	0	6	14	11	8	5	0	0	0	0	0	0	0	0	0	0	0	0	9	9	5.6	12	
December		9	4	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	3	3	2	0	0	0	1	2	3	4	1.2	15	
1878.																																			
January		3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	4	6	6	12	12	10	5	2	0	0	0	2.0	20	
February		3	9	14	26	30	35	25	18	10	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6.4	14	
March		0	4	8	6	5	6	7	9	5	8	10	12	14	16	20	24	16	2	0	1	2	1	1	1	0	0	0	0	0	0	0	5.7	18	
April		0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.7	19	
May		1	2	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	3.7	11	
June		24	26	28	12	5	3	0	0	0	1	2	3	2	1	0	0	0	0	0	0	1	0	1	2	1	0	8	6	4	2	0	0	4.4	15
July		1	0	0	0	0	0	0	0	0	1	2	3	2	1	0	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	0	.5	5	
August		0	0	0	0	0	0	0	0	5	10	8	6	3	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.1	12	
September		0	0	0	0	0	0	1	0	1	0	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.2	13	
October		0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	1	0	0	0	0	0	1	3	1	0	.4	19	
November		1	2	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.5	17	
December		0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	1	.3	10	
1879.																																			
January		1	2	1	0	0	0	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	.3	13	
February		0	0	0	0	0	0	0	0	0	0	0	1	0	0	2	1	0	0	0	0	0	0	1	2	0	0	0	0	0	0	0	.3	13	
March		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.2	17	
April		0	0	0	0	0	0	0	0	0	2	3	3	4	8	14	10	8	6	4	2	1	1	1	0	0	0	0	0	0	0	0	2.3	17	
May		0	0	0	0	0	1	3	4	4	3	2	0	0	2	4	4	2	2	1	0	0	0	0	0	0	0	0	0	0	0	0	1.1	20	
June		0	0	2	5	8	4	0	0	4	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	5	4	8	10	0	2.1	20	
July		4	4	3	2	1	0	0	0	0	5	4	4	3	1	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1.1	19	
August		0	0	0	0	0	0	0	0	2	4	8	14	8	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3.6	19	
September		3	2	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	.8	24		
October		1	9	1	3	0	0	4	10	16	13	15	17	14	7	3	0	5	10	17	11	6	2	0	0	0	0	0	0	0	0	0	5.3	22	
November		0	0	1	1	0	10	25	20	11	14	16	18	4	3	3	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	5.3	21	
December		3	3	3	2	1	0	0	0	3	2	0	0	0	0	0	2	2	4	3	0	0	0	0	1	2	3	1	0	0	0	0	1.1	15	
1880.																																			
January		2	5	15	24	22	15	16	16	20	24	22	20	26	30	20	18	12	10	7	5	2	1	0	0	0	0	0	3	4	0	3	9	11.5	17
February		14	14	11	11	11	11	11	18	18	18	8	6	4	0	0	0	0	0	1	2	3	3	6	6	3	6	1	1	1	2	2	0	6.4	19
March		3	5	3	1	1	2	2	0	1	4	3	1	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	2	3	4	5	0	2.1	18
April		10	12	20	26	16	10	3	3	5	10	10	10	10	13	13	8	3	3	3	3	4	6	6	0	0	0	8	18	25	12	2	0	9.1	23
May		20	20	20	17	12	10	14	13	12	8	8	4	2	1	1	0	0	0	0	0	7	2	3	4	8	20	22	25	26	28	29	27	11.7	18

Prof. D. P. Todd's sun-spot observations. — Concluded.

Day of month.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Mean daily observation.	No. of days.	
1880.																																		
June	12	8	7	6	4	2	3	7	3	4	5	2	0	1	4	7	10	17	23	23	22	34	30	31	30	33	32	35	28	20		14.8	13	
July	16	12	13	16	20	28	36	30	10	2	0	0	0	0	0	0	4	5	8	12	15	20	20	22	24	18	12	12	6	6		11.8	17	
August	5	3	7	10	12	16	23	25	32	24	26	30	36	40	40	50	52	45	42	40	30	25	10	5	3	6	10	18	20	20	15		23.0	18
September	12	7	3	4	11	20	30	40	55	75	85	80	75	63	48	28	15	20	25	22	20	10	8	14	17	22	32	40	50	70		33.4	20	
October	55	58	60	20	18	12	12	22	24	14	13	12	10	14	13	16	16	25	25	25	25	20	24	25	24	22	20	18	16	14	10		21.4	16
November	22	25	24	20	16	10	3	3	5	2	0	3	8	12	15	17	20	25	35	28	20	12	12	10	14	18	22	25	22	20		15.6	15	
December	15	15	10	14	20	22	25	20	15	15	10	10	8	2	0	4	9	12	12	14	5	4	14	13	10	8	6	4	3	6	10		10.8	18
1881.																																		
January	10	11	12	13	14	12	11	10	8	6	4	3	2	4	6	10	15	20	18	16	10	3	8	20	28	35	50	55	56	55	50		18.5	13
February	45	35	25	25	25	40	40	35	25	15	15	10	10	12	17	20	25	20	13	22	18	16	12	11	10	8	4	3		5	7		19.9	19
March	6	8	5	1	1	3	4	12	22	35	45	47	50	85	85	80	70	55	40	45	60	60	40	15	9	2	3	4	5		31.9	21		
April	8	10	20	20	20	18	14	12	10	8	7	11	15	20	40	47	55	65	75	90	115	100	85	60	58	55	35	10	7	5		36.5	16	
May	6	8	12	14	15	14	13	18	18	17	20	22	13	8	8	6	4	2	1	4	9	16	26	30	37	44	56	48	60	65		20.4	22	
June	60	55	50	45	35	20	9	15	22	30	40	45	47	48	50	40	33	25	15	12	10	5	10	17	25	40	50	57	65	60		34.5	14	
July	45	40	35	25	35	25	27	30	35	35	30	25	22	20	19	20	15	13	15	15	15	20	35	50	60	70	80	110	120	110		34.4	24	
August	50	40	35	25	19	25	25	26	20	15	10	8	3	0	0	8	4	5	6	10	35	50	60	70	80	110	120	120	110		36.0	22		
September	100	85	70	55	40	30	25	20	15	20	25	30	30	25	20	25	25	20	15	12	10	8	5	3	4	7	9	9		25.7	16			
October	9	20	35	30	20	25	25	20	20	18	17	16	15	14	12	13	14	15	25	45	40	40	35	30	22	21	20	18	15	17		21.5	16	
November	8	6	4	2	2	3	6	9	15	20	20	18	20	20	35	35	34	35	35	36	35	33	30	22	21	20	18	15	17		19.8	12		
December	25	30	32	34	35	30	28	25	30	35	30	35	30	27	26	25	20	17	12	10	9	8	6	12	9	9	10	12	12	15		21.0	16	
1882.																																		
January	15	15	17	20	17	15	15	15	15	12	14	16	18	20	20	16	12	18	20	18	15	12	12	11	14	17	20	22	25	20	19		16.6	18
February	18	15	20	25	30	35	37	35	42	50	60	55	57	60	60	55	45	30	25	20	15	20	25	30	30	25	20	10	10	5		32.1	19	
March	10	20	25	25	30	35	30	30	25	22	20	20	23	24	24	25	20	20	35	35	32	30	30	30	30	25	20	15	20	35	30		25.6	17
April	30	40	40	41	43	45	45	45	45	50	57	65	55	60	70	85	125	160	140	125	110	95	60	20	14	12	11	12	9	8		57.1	16	
May	12	20	18	20	25	33	44	55	55	60	65	70	75	80	85	90	90	90	90	62	35	20	10	6	3	3	4	5	4	6		40.5	19	
June	2	7	8	7	6	5	11	19	25	27	28	35	37	40	45	50	52	55	55	50	45	40	35	25	30	35	35	35	35	40		29.3	22	
July	38	35	40	32	25	12	5	0	0	15	30	25	30	40	45	40	35	35	35	35	37	40	32	25	25	20	30	15	20	25		27.0	23	
August	25	21	17	12	10	5	3	7	10	10	10	10	8	7	2	2	10	35	35	31	28	25	25	24	20	21	25	30	30	30		16.0	23	
September	17	25	35	45	45	40	35	20	16	12	16	16	20	25	27	31	35	35	35	31	28	25	25	24	20	21	25	30	30	20		27.1	18	
October	45	45	50	40	40	30	5	2	0	5	7	9	12	17	26	35	45	47	50	50	47	41	38	35	25	20	19	18	20	25		27.4	21	
November	35	35	35	30	25	20	25	30	25	27	30	25	24	20	15	17	21	25	30	35	40	35	30	27	25	35	35	35	25		28.0	17		
December	10	10	0	5	6	8	8	15	17	19	20	19	15	10	30	28	25	20	15	10	14	8	6	6	4	2	4	10	15	12	10		12.4	14
1883.																																		
January	8	6	2	4	6	7	8	7	5	6	6	12	16	20	30	28	27	25	23	20	18	20	15	10	8	8	7	4	2	6	14		12.2	11
February	20	20	20	17	15	22	30	25	25	31	45	55	45	35	25	20	20	20	15	10	6	3	0	2	3	4	7	7	25	24	21		19.7	20
March	6	5	3	2	0	2	4	6	10	15	10	6	4	8	12	17	20	20	20	20	25	30	25	30	25	30	27	25	24	22		15.0	17	
April	20	22	25	30	35	32	30	30	25	20	25	35	40	60	67	70	67	65	65	55	45	40	30	20	20	20	15	12	10	8		35.8	21	
May	10	7	10	9	8	7	9	9	11	14	12	9	7	12	11	10	11	11	12	11	10	8	4	2	0	0	0	0	1	1	4		7.4	23

Plotting the monthly numbers, it will be seen that there are plain indications that the maximum has passed, though it is thought by some that it is still to come.

H. A. H.

*FIFTEENTH ANNUAL CONVENTION OF
THE AMERICAN SOCIETY OF CIVIL
ENGINEERS.—I.*

THE members of the society began to assemble in Chicago as early as Thursday, June 14, to visit the exposition of railway appliances, and to take part in the excursions planned for their benefit by the Engineers' club of the north-west.

By Monday morning, June 18, the number of those intending to take the special train for St. Paul, generously tendered by the officers of the Chicago, Milwaukee, and St. Paul railway, had swelled to three hundred. The train of eight cars, well filled, left Chicago at 7.30 A.M., arriving at St. Paul at 10 P.M. But few stops were made on the way, the principal one being at the crossing of the Wisconsin River, for the object of inspecting the railway bridge, and taking a better view of the fine scenery at that point. Quite an accession to the party came on board at Milwaukee.

Upon reaching St. Paul, an engine of the St. Paul, Minneapolis, and Manitoba railroad was attached; and the train was drawn over that line, through Minneapolis, to Lake Minnetonka, — a beautiful sheet of water some thirty miles long, where, at Hotel Lafayette, thirty-three miles from St. Paul, the members of the society and their invited guests were to be quartered during the convention.

The two cities of Minneapolis and St. Paul, only a few miles apart, and each containing over eighty thousand inhabitants, were rivals for the opportunity of entertaining the society; and to prevent any ill-feeling, as well as to avoid crowding any of the city hotels, already taxed to accommodate their own patrons, this summer hotel, just opened for the season, only built one year, newly enlarged and furnished, and capable of providing for the comfort of five hundred or six hundred guests, was chosen for headquarters. With the exception that some valuable time was lost in going to and returning from the place of holding the daily sessions, this selection is to be commended; for the location was extremely pleasant, and the air fresh and cool. Those who did not desire to go to the meetings each day could find rest and enjoyment at this agreeable summer resort. A special train was at the service of the convention each day throughout the entire

week. A large accession to the number of members present was made as the week progressed, so that the attendance was larger than at any previous convention.

On Tuesday morning the engineers took the special train for St. Paul, and thence went to the state capitol, where the first meeting was called to order in Representatives' hall. After formal announcements of programme and arrangements, the usual addresses of welcome were made.

The first paper read was by the late Major F. U. Farquhar, U.S. eng., on the building of the dike for the preservation of the Falls of St. Anthony.

The falls, which furnish the water-power for the mills of Minneapolis, were first described. A stratum of upper magnesian limestone, eleven feet thick at the lower edge, is underlaid by an extremely soft sandrock, which is rapidly worn away; and the limestone is thus undermined and broken off. The recession of the falls was rapid; and, as the limestone outcrops with a thin edge twelve hundred feet above the present brink of the falls, their final reduction to rapids would occur, if not prevented. Citizens dug a tunnel for a tail-race in the sandrock, and the river broke in at the upper end. The immediate destruction of the falls was imminent; and attempts to check the rush of water, which rapidly enlarged the tunnel and repeatedly broke through in different places, proved ineffectual. The citizens, after building cofferdams at various weak points, discouraged by failures at times of high water, obtained an appropriation from the U. S. government, on the ground that the wearing-away of the falls would injure navigation above. A plan was finally proposed by Major Farquhar, of excavating a tunnel across the entire river, through the sandrock, from the limestone overhead to the sound rock below, some forty feet, and filling it solidly with concrete. This work was carried out under his direction, and was fully explained in the paper, and illustrated by drawings. The dike is eighteen hundred and seventy-five feet long, and has successfully shut off the water which worked its way through the soft sandstone. The detailed statement and cost can be found in the Report of chief of engineers, U.S.A., for 1879. The action of the water has been injudiciously concentrated upon a limited space of some three hundred feet by the erection of wing-dams by the mill-owners.

In the discussion on this paper at the time of its reading, and in remarks made the next morning by the engineer officer now in charge

of the falls, the other works of preservation—the timber apron, the rolling dams above, and the crib which had been placed below, the falls—were described and commented upon.

Dr. C. E. Emery read a short paper, and submitted a table, showing the cost of steam engines and boilers complete, and the cost of operating the same for three hundred and nine days in the year, including repairs and renewals, and giving, upon the data assumed, the total cost per horse-power maintained continuously. He pointed out why small engines were comparatively more expensive to maintain than were large ones. The discussion of this paper was postponed until the next day.

The convention re-assembled at the state capitol on Wednesday morning. The discussion of Messrs. Farquhar and Emery's papers was first in order. The question was asked whether the amount expended in the preservation of St. Anthony's Falls would not have sufficed to establish and maintain an equivalent plant of steam-engines. Dr. Emery thought not.

Prof. T. Eggleston followed with a paper on 'An accident to steam-pipes arising from the use of blast-furnace wool.' He attributed a corrosion and subsequent explosion of steam-pipes at Columbia college to the setting-free of sulphur from the wool by the action of extremely diluted solutions of organic acids and the rapid corrosion of the pipe by the sulphuric acid, sustaining his position by reports of analyses and tests.

He was strongly opposed by Dr. Emery, who claimed that the corrosion was due to leakage and moisture, with alternate wetting and drying of the pipes, and that blast-furnace wool was entirely innocuous.

Mr. John Lawler of Prairie du Chien described the construction of the two pontoon draws in the railway-bridge across the Mississippi at that place. Each pontoon is four hundred and eight feet long, six feet deep, thirty-six feet wide on bottom, and forty-one feet wide on top. The interior details, the regulation of height of track, the means for fastening and for manœuvring the draws, were described at length; and the cost was stated as one-sixth of the estimated cost of the usual iron swing-bridge. The bridge was built in 1874, and has been in continued use ever since. This bridge was seen from the train on the trip from Chicago.

The last paper at this session, by G. Lindenthal of Pittsburgh, Penn., was upon the rebuilding of the Monongahela bridge at that

place, from his design and under his direction. The first portion of his paper entered minutely into details of the new structure, and was illustrated by tracings. The latter portion was occupied with a discussion of the old suspension-bridge, built in 1846 by John A. Roebling, the condition of the same before removal, the tests of the material removed, and the effect of the excessive overloading to which it had been exposed for years by the increasing and heavy traffic over the bridge.

After a brief discussion, the convention then adjourned; a portion of the members repairing at once to Lake Minnetonka, and the remainder going to Minneapolis, where visits were made to the Washburn flouring-mill and to the bridges.

(To be continued.)

KINETIC CONSIDERATIONS AS TO THE NATURE OF THE ATOMIC MOTIONS WHICH PROBABLY ORIGINATE RADIATIONS.¹—I.

THE assumption that the mean kinetic energy of translation of the molecules of a gas is the measure of its temperature is one whose beautiful agreement with experiment has led to its acceptance as a necessary part of the kinetic theory of gases, and it has often led to the thoughtless conclusion that this translatory motion is also the mechanical source of the disturbances in the ether which originate radiations. But there are many difficulties in the way of accepting this view. One of the first, and perhaps the least, is the difficulty of conceiving how such a motion of translation, which is essentially longitudinal, can originate a lateral vibration, such as light and radiant heat must be.

A greater difficulty appears to be found in the extremely moderate mean velocity of translation which the molecules of a gas are found to have. Molecular velocities, which are of the same order of magnitude as that of sound or of a rifle-ball, seem hardly fitted to cause the necessary compressions or disturbances in a medium in which the rate of propagation is so immense; or, to state it in another way, if molecules, in describing their paths, originate radiations, then the motion of a rifle-ball ought also to do so, or, indeed, any much more moderate motion, such as that of a vehicle or animal.

A still further difficulty is, that there is another part of the kinetic theory which appears to be so related to this that both cannot

¹ Presented in abstract to the Section of chemistry and physics of the Ohio mechanics' institute, April 26, 1883.

be rigorously true at the same time, as appears from the following considerations. The most probable distribution of the component molecular velocities of a gas in equilibrium is the same as that of errors of observation. This distribution is brought about by fortuitous molecular encounters, and its permanence is insured by reason of them. But in case the progressive motion of a molecule gives rise to radiations, those molecules whose velocities are the greater are the hotter, and consequently radiate more heat to other molecules than they receive from them. They therefore lose part of their progressive energy before the next encounter. The whole effect would be to retard the motion of those molecules whose kinetic energy is greater than the mean, and accelerate those whose kinetic energy is less. This would cause a constant interference with the distribution of velocities according to the law of probabilities; and the interference would, so far as we are at present able to form an estimate of its amount, be sufficient to cause the kinetic energy of each molecule to approach indefinitely near its mean value during the time in which it describes a very small fraction of the mean path between two successive molecular encounters. If this is the case, the kinetic energy of any molecule does not differ for any appreciable time from its mean value, and is in effect the same during the whole path, so that there is no such distribution of velocities as has been assumed. In case the interference with the assumed law is not so complete as this, it must apparently exert an important influence upon the distribution of velocities, especially in the case of rarified gases, in which the encounters are comparatively infrequent.

Again: if the progressive motion of the molecules can originate radiations consisting of transverse vibrations, it would appear highly improbable that their rotary motion should not also do the same. But, as has been shown in a former paper,¹ the kinetic energy of translation differs from that of rotation for imperfect gases; and the temperature cannot be simply proportional to the mean rotary energy, though it might possibly be proportional to the sum of the rotary and translatory energies combined.

But aside from these difficulties, which may serve to show the intrinsic improbability of the supposition that the progressive motion of the molecules originates radiations, we seem to reach pretty decisive evidence against the supposition, when we consider the specific heats

of solid bodies, or when we consider the nature of the radiation itself as revealed by the spectroscope.

The experimental law of Dulong and Petit, and the analogous results of Neumann,¹ show that in solid bodies we must consider the temperature to be measured more nearly by the energy of the atom than by that of the molecule. Now, it is hardly supposable that the translatory motion of a gaseous molecule should originate radiations, while that of a solid should not. We shall not, at this stage of the discussion, consider the spectroscopic evidence as to the nature of the motions which originate radiations, further than to notice that the characteristic spectra of gases appear wholly inexplicable, on the supposition that they are originated by translatory motions, with velocities distributed according to the law of probabilities, or with velocities reduced by radiation to an approximate equality, as it has been shown they might be; for even the simplest gases have spectra consisting of at least several lines.

If these reasons compel us to distrust the supposition that radiations originate in the progressive or rotary motions of the molecules, does the supposition that radiations originate in the vibratory motion, with respect to each other, of the atoms in the molecule, afford a better explanation of the facts? Such a motion, analogous to the elastic vibrations of a bell or other sonorous body, might very readily, perhaps, be shown, in case of a complex molecule, to have such a relation to the molecular encounters, and thus to the mean kinetic energy of translation, that its energy would be directly proportional to it for each given gas. In case this were established, such vibrations, considered as the physical cause of radiations, would explain the phenomena of gases as well as the supposition that they are due to the progressive kinetic energy; and they might possibly be shown to explain those of solids also.

But there is at least one difficulty, in the way of accepting this supposition, which seems insuperable in the case of monatomic molecules; for, if radiations could only originate in the vibrations of atoms with respect to each other within the molecule, monatomic molecules could not radiate heat at all, and could not have a temperature. That this should be true is not only inconceivable, but contrary to the known fact that monatomic mercury gas has a perfectly ascertainable temperature: hence

¹ An extension of the theorem of the virial, etc.—(*Sc. proc. Ohio mech. inst.*, March, 1883.) See also *SCIENCE*, 1. 65.

¹ *Ann. phys. chem.*, xxiii. Wüllner's *Experimental-physik*, iii. 506.

the motions which originate radiations are not confined to such vibrations of atoms, even if it be possible that such vibrations do originate radiations. And this consideration leads us to what appears to be the truth of the matter, which is, that the atoms themselves are in a state of internal vibration. As will be seen subsequently, this internal vibration is, no doubt, accomplished under the action of internal forces, which permit extremely small deformations only of the atom by any external forces which can be brought to bear upon it; i.e., the modulus of elasticity of an atom is very large indeed, and very large, no doubt, when compared with that of the molecule. Indeed, if such vibrations exist within the atom itself, it is not difficult to prove that the force which binds the parts of an atom together (and consequently its modulus of elasticity) is much greater than the chemical force binding the atoms together into a single molecule; for it has been shown, in my paper upon the internal molecular energy of atomic vibration, that the amount of energy which can be imparted to a system like this is inversely as the modulus of elasticity. But chemical atoms are bodies which we are now supposing to be in internal vibration, but to which it has been found impossible to communicate energy in amount sufficient to cause them to fly to pieces. Since atoms do not become decomposed, while molecules do under various circumstances, it must be that their modulus of elasticity is much larger than that of molecules.

This view accords with that of Lockyer,¹ who has endeavored to explain the coincidence of lines in the spectra of different elements, and the relation of temperature to spectra, by the supposition that the so-called chemical elements are merely molecules which have never yet been decomposed by chemists. It must be admitted that the experimental evidence he adduces is of a very cogent character; and it seems to me that the demonstration by which I have shown that the mean energy of such a vibration would be extremely small explains how such a vibration can exist without decomposing the more complex atoms even at the highest artificial temperatures, though Lockyer has reason to think that they are decomposed in the hotter stars, where only the spectra of the elements of low atomic weight are to be found.

Were it true that every degree of freedom must have the same kinetic energy, we could

not admit the possibility of such a vibration; for not only would such large amounts of energy be required by the degrees of freedom which seem certainly to exist between the atoms of complex molecules as to entirely contradict experimental values of the specific heat, but the supposition of additional degrees of freedom within each atom would require an amount of energy, on the whole, many times the actual specific heat of such bodies. But when the amount of energy required by such degrees of freedom is nearly a vanishing quantity, as I have shown, there is nothing to prevent us from assuming that to be the truth which spectroscopic evidence makes most probable.

We may notice, in passing, that the principle upon which this paper rests, that vibrations of this character can exist without absorbing an appreciable amount of kinetic energy, enables us to explain at the same time the extremely moderate rate at which exchanges of heat take place between bodies by radiation. They become only very slowly of the same temperature, which fact needs explanation in view of the extremely rapid propagation of radiations themselves. Now, according to our supposition, during a molecular encounter the molecules are roughly shaken, and there is a determinate distribution of energy to be found among the atoms, at its conclusion, in the form of internal atomic vibration, which distribution is due to the circumstances of the encounter. Those atoms which by chance have more energy than others radiate more rapidly; and since the velocity of radiation is so great, and the atomic distance so small, we may assume that the several atoms acquire almost instantaneously an energy of internal vibration sensibly equal to the mean, so that in a gas this is their condition during almost the entire free path of a molecule. In case the gas is becoming cooler by radiation to surrounding bodies, the atoms which radiate to these bodies lose more of their vibratory energy than they otherwise would, and thus have less mean energy of internal vibration than they should have under the law of distribution which determines what fraction this energy shall be of the mean kinetic energy of the molecules. At the next encounter, the atoms receive their proper share of the mean kinetic energy, which, being partially lost by radiation, is again supplied; and so on. And because this transformation into internal atomic vibration must take place before it can be radiated, and because at the same time the energy of this vibration is but an unappreciable fraction of

¹ Discussion of the working hypothesis, that the so-called (chemical) elements are compound bodies (*Nature*, Jan. 2 and Jan. 9, 1879). Necessity for a new departure in spectrum analysis (*Nature*, Nov. 6, 1879).

the total kinetic energy, the process of exchange by radiation is, on the whole, slow. Were, however, the translatory motion the direct cause of radiation, the exchanges between diathermous bodies must apparently be nearly instantaneous.

(To be continued.)

OYSTER-CULTURE IN HOLLAND.

THE first of a series of papers on the European oyster and oyster industry of the Eastern Schelde¹ has just been published by Mr. P. P. C. Hoek, secretary of the commission of the zoölogical station of the zoölogical society of Holland. It is to be followed by a series of papers gotten up in similar style by eminent specialists: 1°. On the embryology of the European oyster; 2°. On its food, parasites, and commensals; 3°. A review of the fauna of the Eastern Schelde; 4°. A report on the physical conditions presented by the Eastern Schelde; 5°. A report on experiments made to determine the conditions under which the fixation of the larval oyster occurs.

In this report the author devotes a short chapter to a discussion of the classical allusions to the animal, from the Homeric period to the time of Oppian. Then comes a chapter on the references to the oyster found in Conrad Gesner's *Historia animalium*, lib. iv., edition of 1620; followed by an exhaustive bibliography of ninety pages, in which the works of upwards of two hundred and seventy-five authors are mentioned, covering the period from 1685 to 1883, or nearly two hundred years.

Then follows a paper on the organs of generation of the oyster, by Mr. Hoek, accompanied by an excellent series of lithographic plates representing microscopic transverse sections of the European oyster. The text of this is in Dutch and French on alternate pages. A chapter is devoted to a historical résumé of our knowledge of the anatomy of the generative organs, and is succeeded by an account of the author's investigations.

A second part is devoted to the physiology of reproduction, and is preceded by an historical sketch of this part of the subject, from the time of Leeuwenhoek to the present. The author gives a summary of his results, both anatomical and physiological, as follows: the genital gland is not a compact organ: it lies on the surface of the body of the animal under a thin layer of connective tissue (mantle), below which branched ducts spread out over the reproductive organ, connected on the inner side with the reproductive follicles, which have a generally vertical direction to the surface of the visceral mass, and which anastomose with each other. The generative products develop on the walls of the follicles, the ova and spermatozoa being formed side by side. The author

inclines to the belief that the generative products are developed from the ectoderm. The ova are developed from single epithelial cells adherent to the wall of the parent follicle, while the mother-cells of the characteristic masses of spermatozoa are only portions of such cells. The organ of Bojanus does not have a compact structure as in other lamellibranchs, but is composed of a mass of ducts and blind sacs, which forms a thin flat plate of considerable extent. Contrary to what may be noted of the reproductive glands, the organ of Bojanus extends somewhat into the mantle. The ducts and cavities of the organ of Bojanus pour their contents into a longitudinal cavity, — the urinary chamber, — the walls of which are also excretory in function, and open outwardly by way of a short urinary canal. The external orifice of the renal organ opens into the same cleft as the genital duct, a little behind the latter, but they do not actually join. These genito-urinary sinuses lie below the adductor on either side of the ventral process of the body-mass. A reno-pericardiac canal connects the urinary chamber with the pericardiac cavity. It is probable that the auricles of the heart also exercise an excretory function.

An oyster which has fry in the branchiae is the parent of the same. At the moment of emission from the ovaries, not only have the ova been fertilized, but they have also passed through the first stages of segmentation. The sperm necessary for fecundation does not come from the same parent. The water which flows over other oysters in the vicinity charged with sperm, which they have set free, is carried into the mantle-cavity of egg-bearing individuals, and into their genital ducts and their branches. The oysters of the Eastern Schelde are two years old before they have brood; they are most prolific at the age of four or five years. There are more sperm-bearing oysters in the Eastern Schelde than egg-bearing ones. All of the mature eggs are laid at once; the production of sperm is probably continued for a longer time. In every instance that was investigated, the production and emission of ova is followed by a period during which no sperm is produced. A large proportion of the spat found fixed on the banks in the Eastern Schelde was probably not derived from the oysters inhabiting the cultivated beds. Culture appears to act injuriously upon the reproductive powers of the animal. In old oysters the liver is much more developed than in younger ones. This greater development of the liver is dependent upon the less marked development of the reproductive organs.

J. A. RYDER.

GALTON'S HUMAN FACULTY.

Inquiries into human faculty and its development.
By FRANCIS GALTON, F.R.S. New York, Macmillan, 1883. 12 + 380 p., 6 pl. 8°.

MR. GALTON'S researches have for a good while attracted the attention of English and American students of psychology and anthropology. As they are here brought together,

¹ *Verslag omtrent onderzoekingen op de oester en de oester-cultuur betrekking hebbende. Aflevering i.* (With title in French: *Rapport sur les recherches concernant l'huître et l'ostreiculture. Livraison i.*) Leiden, E. J. Brill, 1883. 253 p., 5 lithographic plates. 8°.

the practical purpose of their author is impressed upon us more clearly than ever. Mr. Galton means to introduce to our notice new aspects of the study of human character. He wishes to make this study more exact and scientific by founding it upon detailed investigations of facts previously neglected; and he proposes to offer the results as useful for a future science or art of eugenics, which shall teach the human race how to breed so that its best stock shall be preserved and improved, and its worst stock gradually eliminated. This seemingly utopian end is to be gradually approached by the formation of a public sentiment that shall encourage a new sort of family pride and exclusiveness; namely, when eugenic science has taught us what are the most useful human qualities, what their accompanying marks, what qualities are best transmitted to posterity, and what are the conditions that favor such transmission, then people otherwise not known to fame will be able, by a proper study of their family history, to discover their inherited wealth of valuable qualities, and their resulting eugenic rank; and such persons will be respected by an enlightened public according to their rank. People who rank high in the eugenic scale will be unwilling to contaminate their stock by unions with persons much lower in the scale, and their feelings in this matter will be appreciated. Thus marriages will become less blind, and civilization will progress faster.

That Mr. Galton's researches will be of much immediate use to young people about to marry, no truthful reviewer can promise; but to the psychologist, at least, they are in their present condition both attractive and useful; and, for the rest, it is much for Mr. Galton merely to have suggested, more definitely than Plato was able to do, that there ought to be, and some day may be, a real art of eugenics, which may be of practical importance for mankind. Just yet, neither Mr. Galton nor any one else can hope to do much more than to insist that the best parents may be expected to produce the best children; but there are many ways of insisting. Mr. Galton's most important contribution to this practical aspect of the subject lies in the facts that he has collected to give new importance to the matter by proving the vast predominance in ordinary cases of the influences of nature over those of nurture. Nature means for Mr. Galton the sum of all the inherited qualities of the individual, while nurture stands for the educating influences of the environment. In case of twins, Mr. Galton collects facts to show that

in one strongly marked class of such persons the resemblance between the twins is very strong from the outset, and then often extends through life to the smallest possible matters of physical and mental condition, even when the twins live far apart. But in other cases, which form a second equally marked class, the twins, contrasting somewhat strongly from the outset, never are brought nearer to likeness, notwithstanding all the similarity of the circumstances of their nurture and training. Thus, when the physiological conditions of their origin give them like nature, difference of nurture does not prevent very striking similarity throughout life; while, where the conditions of origin favor unlikeness, likeness of nurture goes but a little way to overcome the contrast. A similar result is indicated, according to Mr. Galton, by our experience with races of animals, some of which seem by nature disposed to domestication, while the stubborn nature of others resists the advantages of any nurture, so that they remain wild, however much we may try to tame them. From whatever side, then, the matter is viewed, nature seems superior in its persistence to the forces of nurture that opposed this persistence; and, if we want human stock to grow better through voluntary effort, we must undertake to study and improve pre-natal and ancestral influences yet more than we try to better the influences of education.

This, then, is Mr. Galton's most significant practical result. His researches upon various problems of the science of character, that have not yet been long enough studied to have much immediate practical significance, cannot easily be summed up in one short notice. The psychologist is most interested in his researches on mental imagery and on association of ideas. Mr. Galton is of the opinion that introspection can be made a more exact science than psychologists have previously found it. And so, indeed, it can be, no doubt, at least when it is limited to the lowest orders of mental facts. Here introspection is greatly aided by plain and simple questions. Ask a man to tell you all he can about what now goes on in his mind, and he will answer as wildly as you could wish; but ask him to call up in mind the picture of his hat or of his house, or to tell you whether in some concrete instance he can vividly remember musical harmony as distinct from melody, and most honest men can then answer intelligibly and usefully. It is Mr. Galton's service to have shown how much can be done by thus systematizing and simplifying the method of introspection, so that people who are

not psychologists may be able to furnish to the psychologist important and trustworthy data.

We do not remember that our author is quite plain in defining one of the safeguards needed to make this method useful. He says, in describing his researches into mental imagery (p. 87), "The conformity of replies from so many different sources, which was clear from the first, the fact of their apparent trustworthiness being on the whole much increased by cross-examination, and the evident effort made to give accurate answers, have convinced me that it is a much easier matter than I had anticipated, to obtain trustworthy replies to psychological questions. Many persons, especially women and intelligent children, take pleasure in introspection, and strive their very best to explain their mental processes. I think that a delight in self-dissection must be a very strong ingredient in the pleasure that many are said to take in confessing themselves to parish priests." But there is an obvious moral from all this. The method, with its questions and cross-questions, with its interested subjects and their pleasure in confessing themselves, is indeed fruitful; but the outcome must be controlled by the maxim that the subject's statements, when he is not himself an expert, must be trusted implicitly only when they are out of relation to any preconceived theory of his own about his mind, and equally out of relation to any popular prejudice or superstition that could influence him. Generally Mr. Galton seems to follow this maxim without explicitly recognizing it. The simplicity of his questions is itself a security. If you ask about one's mental picture of his breakfast-table or of his hat, you can be tolerably sure that he has no prejudices or superstitions that will affect his answer. But it is another thing, in case one is inquiring about the 'visions of sane persons,' and mentions some great man, say Napoleon, who is declared by some one to have had visions of his 'star,' and to have boasted thereof. Here such evidence as can be got would be worthless, even if the great man in question were not a notorious liar. For superstition, once for all, attributes stars to great men; and, when a story exactly corresponds to a known and wide-spread superstition, we may usually disregard the story save for the purposes of folk-lore. Yet, on p. 176, Mr. Galton makes a story of this sort the basis of reflections that of course may possibly be true; so that his caution is not quite perfect.

In fact, we should be disposed to apply the maxim just stated yet more carefully; namely, if the subject shows an uncommon visualizing power, he is both instructive and dangerous, and ought to be treated very tenderly. He can furnish many facts, but his replies are by so much the more apt to be influenced by some theory of his own. Accustomed all his life to his vivid imagery; very possibly a member of a family several of whom are uncommonly gifted in this respect; accustomed, therefore, to notice and talk about his power, and perhaps to boast of it,—he may have formed already some vain-glorious idea of what he can do or ought to do; and, when you set him at the task of talking about himself, you must be careful how you accept all that it may occur to him to say. A brief experience with one such subject as we have just described has convinced us that serious danger would arise from applying Mr. Galton's method to him without great care. And if we intended to publish any of his experiences, we should confine him strictly to commonplaces, should not publish his stories of what he used to see when a child, and should not introduce any thing that he connected with 'elevated spiritual experiences,' or with any other artistic excellence of which he seemed to feel proud. We fear that some of Mr. Galton's subjects needed more such watching. In fine, though Mr. Galton's researches on mental imagery, since their first publication in the form of memoirs, have greatly helped introspective psychology, no one, doubtless, would fear or deplore more than himself any misuse of them that should tend once again towards the mythological. Our suggestion is intended to help to ward off such a sad result, which, for the followers whom Mr. Galton is certain to have, might not be very far off. What might not our author have to mourn over, if 'psychological associations' were to become fashionable in country towns, and were to produce acres of manuscript or printed proceedings containing elevated spiritual visualizing experiences by old maids and semi-spiritualistic reformers? Yet, in these days of popular science and associations, who knows what Mr. Galton's pleasing way of speech might not produce, if he does not add to every new chapter of facts a note strenuously insisting that the exact and cautious methods that are commonplaces for him should be studied and followed by every ambitious one that would do likewise, however simple the subject-matter investigated may seem to be?

Mr. Galton can claim especial credit for his

investigations into visualized number-forms. Here the nature of the facts is the best guaranty of their general accuracy. They have generally been unknown, save to the subjects; they are not things of which people are apt to boast; their psychological significance is far greater than their popular interest; they have nothing of the elevated or of the spiritual about them; the research is quite new. All this secures the substantial correctness of the results, though, plainly, further accurate research will become harder when Mr. Galton's facts become more popularly known.

One general result that Mr. Galton seems to have established is, that growth in the power of abstract thought is opposed to the free development of the visualizing faculty. Scientific men have, as a rule, less vivid imagery than persons of less abstract habits of mind. Adults visualize less clearly than children. But this loss of visualizing power does not signify, he tells us, loss of clear memory of details. "Men who declare themselves entirely deficient in the power of seeing mental pictures can, nevertheless, give lifelike descriptions of what they have seen." Again: "it is a mistake to suppose that sharp sight is accompanied by clear visual memory." Yet more: "the visualizing and the identifying powers are by no means necessarily combined." Thus our author tells us that one distinguished subject is good at recognizing faces, but cannot visualize them at all. All these facts, and many others, seem to us to point to a result that Mr. Galton sometimes approaches, but does not distinctly formulate. On the contrary, in one place he says something directly opposed to it. "A visual image," he says (p. 113), "is the most perfect form of mental representation, wherever the shape, position, and relations of objects in space are concerned." And he thinks that mere laziness is responsible for the common starvation of this faculty; but, if this were so, it is hard to see how a healthy mental organism should, in the course of its normal development, generally tend to outgrow the visualizing faculty. 'The most perfect form of mental representation' for any purpose will not be the one that we should, as evolutionists, expect to find growing naturally less as the mind devotes itself more to that purpose; yet who are more concerned with the exact relations of things in space than workers in the details of descriptive natural science? And they, we are told, are apt to lack the faculty in question. The statement just quoted seems, then, to lack probability, and to be against the main result

to which, as we have said, all these researches seem to lead.

This result, we think, is that the clearest memory, in the long-run, tends to be the memory of acts, and not of the content of a sensation apart from its immediate relation to an action. This seems reasonable from the point of view of evolution. The life of an animal consists in doing what seems best under the circumstances; and the seeming is determined by instinct or individual experience, coupled with immediate sensation. All, then, that sensations mean for the animal, is summed up in saying that the sensation is useful as the sign of the need of a certain kind of action. The association of a given kind of sensation with a given kind of action results from individual or ancestral experience; but, in forming this association, not the whole of an experience need be remembered, but only so much as shall serve as a sign of a given sort of action. The mouse, even if it fled from the cat, not by instinct, but voluntarily, would still not need to visualize cats, but only to remember so much of the sensations aroused by a cat's presence as should suffice to arouse the right action.

On the other hand, if a given action is to be not automatic, but voluntary, the action must be conceivable clearly and in detail. If this is so, it will follow that the memory for ideas connected with muscular sensations, and so for actions, both bodily and intellectual, would not merely be capable of substitution for visualized images, but would normally tend to be so substituted. In fact, if a visualized image were the 'most perfect form of mental representation' for space relations, then geometrical reflection and definition would be a useless amusement in all cases of small objects. The other facts noted above, such as the relative power to identify without being able to visualize, seem to us capable of explanation in a similar fashion, by the relative preponderance of the memory for actions, and consequently of relations (which we know by virtue of our own bodily and mental actions), over the memory of the contents of bare sensation.

But we have said nothing of Mr. Galton's composite photographs, of his researches on association, or of the many other topics that render his book not only very amusing, but especially instructive, as showing how what in the hands of another man would be mere dilettanteism becomes in the hands of the master a very valuable series of contributions to science. And with these suggestions we must leave a very pleasant topic.

STOWELL'S MICROSCOPICAL DIAG-
NOSIS.

Microscopical diagnosis. By CHARLES H. STOWELL, M.D., and LOUISA REED STOWELL, M.S. Detroit, G. S. Davis, 1883. 8+93+118+35 p., 10 pl. 8°.

THE title of this book led us to expect a work specially referring to the applications of the microscope in medical practice, and we felt that a good book of that scope would be welcome and valuable. As in the opening sentence of the preface Professor Stowell says it has been his good fortune to be so situated, during the past few years, that his entire time has been devoted to the study of histology and microscopy, with special reference to the microscope in its relation to the practice of medicine, our anticipations seemed confirmed, and the expectation added, of finding much new and original matter. An examination of the body of the book was disappointing, because it gave us acquaintance with contents so miscellaneous and varied that we were reminded of those so-called 'happy families' where discordant associates live in compulsory peace,—something quite unlike a natural and well-proportioned assemblage.

The first eighty-two pages alone deal with clinical microscopy, and we think not satisfactorily; for the treatment is hurried and incomplete, though certainly accurate, what there is. The best part is the few pages on urinary deposits, with the accompanying admirable plates by Mrs. Stowell. The portion

on parasites and tumors is extremely inadequate. The three specimens of *Demodex* figured, must have encountered some frightful disaster before they were drawn. We regret, that, instead of all this, the author did not prepare a translation of Bizzozero's *Manuale di microscopia clinica*.

The bulk of the book is made up of botanical articles, by Mrs. Stowell, on starch, wheat, and various medicinal plants. These are pleasantly written, and the illustrations display the authoress's skill in drawing; but we miss in these, as in the other parts of the volume, any definite purpose, either of text-book writing or original research. In this connection, we are impressed by the absence of references to scientific literature.

Part iii., by Mr. Walmsley, describes the methods employed by him in the commercial manufacture of microscope slides. It is extremely elementary, and the methods most employed in scientific biology are in large part unmentioned. The same subject of methods has been far better treated by numerous previous writers.

In short, we are quite at a loss to discover the *raison d'être* of this pleasantly and clearly written, as well as beautifully illustrated work. The new and original matter which we looked for, after reading the preface, we have not found; yet the facts and figures seem all to rest upon personal observation.

To the amateur microscopist, the book may well serve as a guide to certain things not elsewhere so well described.

WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

MATHEMATICS.

Classification of surfaces.—In a memoir contained in the Abhandl. kön. akad. wiss. zu Berlin for 1868, M. Christoffel treated of the classification of surfaces by formulating the changes which took place in a geodetic triangle on the surface when it was displaced or moved along on the surface. M. Christoffel was thus led to a classification of surfaces which divided them into four groups. The first group contained all surfaces upon which no displacement of a geodetic triangle could take place without altering the triangle; the second group contained surfaces upon which a geodetic triangle might be displaced without alteration, provided its angles moved upon certain determinate curves; the third group contained surfaces upon which the geodetic triangle might be displaced without alteration in a singly infinite number of ways; and the fourth group contained surfaces upon which the triangle could be displaced in any manner without alteration. In the present paper,

M. v. Mangoldt revises this classification, and shows that the surfaces contained in the third and fourth groups are identical, and that they include all surfaces with a constant measure of curvature, and only these. Also he shows that the second group contains all surfaces which are developable upon surfaces of rotation which have not a constant measure of curvature, and only these. The author further revises a paper of Weingarten's, correcting an error which appeared there.—(*Journ. reine ang. math.*, xciv. i.) T. C. [74]

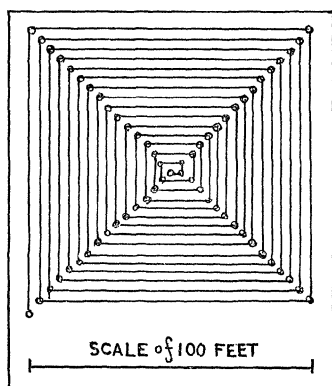
PHYSICS.

Electricity.

Aurora borealis.—Professor Lemström has now given a somewhat detailed account of his apparatus and experiments in Lapland. He and others had years ago in that country observed a peculiar luminosity, which he calls 'phosphorescent,' in the form of 'tiny flames' playing about the tops of small mountains.

As long ago as 1871 an attempt was made to assist the production of the aurora upon these hilltops; but the results obtained were not, to scientific men in general, entirely satisfactory. Accordingly, in 1882, Prof. Lemström prepared to repeat his experiments upon a more extended scale.

Upon the top of Oratunturi Mountain (lat., $67^{\circ} 21'$; long., $27^{\circ} 17.3$ east of Greenwich), about 540 meters above sea-level, he laid out, upon insulators raised about $2\frac{1}{2}$ m. above the ground, a bare copper wire in the form shown in the illustration, the wires being about 1.5 m. apart. The area covered in this way was about 900 square metres. The single wire which made up this spiral was provided with numerous points soldered on; and the inner end was connected by an insulated line with the observing-station at the foot of the mountain, where the circuit ran through a galvanometer and into the earth.



ARRANGEMENT OF WIRES.

From the day the apparatus was finished, viz., Dec. 5, "there appeared almost every night a yellowish-white luminosity around the summit of the mountain, while no such luminosity was seen around any one of the others! The flames were variable in intensity, and in constant oscillation as those of a liquid fire. Three times it was tested, $2\frac{1}{4}$ miles off in south-east, by a Wrede spectroscope (small size with two prisms), and it returned a faintly continuous spectrum from *D* to *F*, in which the auroral line $\lambda = 5569$ with soft variable intensity was observed." The galvanometer, meanwhile, showed an extremely variable positive current from the wire at the top of the mountain to the earth.

An attempt was made to determine approximately the electromotive force of this current by occasionally introducing into the circuit a Leclanché element, and observing the change thus produced. As the insulation of the line leading up the mountain was not good, however, we must accept with caution, as Prof. Lemström admits, the results thus obtained. The current from the mountain top was apparently sometimes less, and sometimes considerably greater, than the Leclanché element produced.

Similar results were obtained at Pietarintunturi

Mountain (950 metres above the sea, in lat., $68^{\circ} 32.5$; long., $27^{\circ} 17.3$ east of Greenwich), where a smaller spread of wire was used.

There seems to be very little doubt that Prof. Lemström has succeeded in producing the aurora at will, or rather in assisting nature to produce it. Some of the conclusions which he draws from his experiments, however, will, no doubt, be received with caution, not because they set forth any thing in itself improbable, but because the experiments described seem too few and rough to decide the matter beyond a doubt. Thus he believes that "the *electricity* which descends into the auroral belt [the circumpolar belt of maximum auroral activity] is the *primary* cause of the greatest part of the terrestrial current, and, through this, of the variations of the magnetic elements." Moreover, finding that in several cases observers in different stations were near mistaking different auroral arcs for the same one, he concludes that "all measurements of the height of the aurora, calculated on those with a long base north and south, are always erroneous, as the two observers *never* see the same aurora. And even those calculations which are based on the measurements of the height and length of an arc from one point, and the hypothesis that the arc extends around the magnetic pole, must be considered very unreliable, as no satisfactory answer can be given as to what results would have been obtained a little farther north or south. This is also the case with aurorae with long bases east and west," etc. He says, therefore, "That the height of the aurora borealis is very variable I fully admit, but in my opinion it has been greatly over-estimated."

It seems probable that a great many people incline to a similar opinion,¹ and will merely regret that Prof. Lemström has not given them some better foundation for their disbelief. For many years, however, the doctrine has been current that auroras frequently exist at a height of a hundred miles or more; and the substance of Prof. Lemström's present arguments against such a belief must have been old for a long time.²

On several occasions it was observed by Prof. Lemström's party that the peculiar spectroscopic auroral line "was returned from every quarter of the horizontal plane, (and) even from the zenith, *without any aurora being visible.*"

Another phenomenon of much interest is a "peculiar phosphorescent 'shine,' or diffused luminosity, which possesses several phases, but the general character of which is a luminosity of a yellow-white color, which renders the night as light as the moon with a thick hazy air." On one occasion "every object around stood out clearly in a yellow-white hazy phosphorescent luminosity of quickly-shifting intensity." Apparently no spectroscope was at hand at this time; but on another night, when a similar 'shine,' less bright, but still sufficient to nearly obscure the stars upon the horizon, was seen, an attempt to discover the auroral line was unsuccessful. It is true that the spectroscope used was not well

¹ *Proc. roy. soc.*, 1879-80, xxx. 332.

² *Amer. journ. sc.*, xxxix. 286.

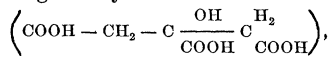
adapted for the purpose; and Prof. Lemström attributes the phenomenon to the same origin as the aurora.

Prof. Lemström refers to Groneman's meteoric theory of the aurora, and no doubt considers it to be disposed of by the experiments above described. It happens, however, that the same number of *Nature* contains an article from Dr. Groneman, in which he says, "I believe I have proved by this research that there existed with the aurora of Nov. 17, 1882, cosmic dust, passing through the upper strata of our atmosphere with great velocity, and giving, according to the most interesting observation of Mr. Rand Capron, 'the usual green line' of the aurora spectrum;" and, further, "It is very remarkable that this experiment comes at the same time as the interesting experiment of Prof. Lemström, showing that electric currents are able to give a development of light in our atmosphere, possessing the same number of undulations in a second as the auroral light. Now our meteoroid being part of an aurora, it gives a stronger proof of the origin of that phenomenon than Prof. Lemström's experiment, the greatest attraction of which is that we are able to repeat it arbitrarily and with our own means. Further, I have always maintained that electricity, excited easily by friction, must be one of the causes of the auroral light . . . and it seems to me very plausible that cosmic matter, approaching the earth, induces electric currents through the air. Therefore I think that the results of Prof. Lemström are in full harmony with the idea of a cosmic origin of aurorae." — (*Nature*, May 17, 31, June 7.) E. H. H. [75]

CHEMISTRY.

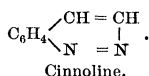
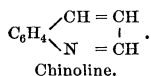
(Organic.)

A new acid occurring in the juice of the beet. — E. O. Lippmann claims to have discovered a new acid in the incrustations which form in the evaporating-pans from the juice of unripe or partially decomposed beet-roots. Analyses gave results corresponding to oxycitric acid



obtained by Pawolleck by boiling chlorcitric acid. — (*Berichte deutsch. chem. gesellsch.*, xvi. 1078.) C. F. M. [76]

Cinnoline-derivatives. — V. v. Richter found, that, by warming an aqueous solution of the diazo-chloride of orthophenylpropionic acid, a carboxylic acid of *cinnoline* was formed, a substance which he regards as an analogue of chinoline.



— (*Berichte deutsch. chem. gesellsch.*, xvi. 677.) C. F. M. [77]

Compounds of the ketones with hydrazine. — The action of phenylhydrazine upon ketones seems to be analogous to that of hydroxylamine. With acetone, H. Reisenegger obtained the compound

$\text{C}_6\text{H}_5\text{N}_2\text{HC}(\text{CH}_3)_2$, which was decomposed, by warming with dilute acids, into acetone and phenylhydrazine. Acetophenonphenylhydrazine resulted from the action of phenylhydrazine upon acetophenon. Oenanthol gave the substance $\text{C}_6\text{H}_5\text{N}_2\text{HC}_7\text{H}_{14}$. With dimethylhydrazine, acetophenon formed chiefly $(\text{CH}_3)_2\text{N}_2\text{C} \begin{array}{c} \text{C}_6\text{H}_5 \\ \text{CH}_3 \end{array}$. — (*Berichte deutsch. chem. gesellsch.*, xvi. 661.) C. F. M. [78]

METALLURGY.

Sulphuric acid from pyrites. — There are very evident advantages in using pyrites instead of brimstone for the manufacture of sulphuric acid, provided the right kind of pyrites is at hand. The qualities necessary are a high per cent of sulphur and iron, in order that the cost of handling may be a minimum. Lead, zinc, calcium, and magnesium can only be present in very small quantity, as they will roast to sulphates, and so cause a loss of sulphur; moreover, they lessen the value of the iron as a by-product. Copper to the amount of two or three per cent is found in some of the best pyrites for this purpose, and is extracted as a by-product. But the especial element to be avoided is arsenic, both on account of the rapid corrosion of the chambers, and the rendering of the acid unfit for many uses. The cost of a ton of oil of vitriol made from brimstone is estimated at \$13.58; made from pyrites, at \$8.22. A number of localities in America furnish pyrites of good quality. The only alterations in the plant are the addition of a Glover tower, and the substitution of suitable kilns, of which illustrations are given, as well as of the Schaffner shelf-burners. — (*Eng. min. journ.*, May 5.) R. H. R. [79]

The Henderson gas-furnace. — This furnace attempts to attain to the highest heats required in the shortest possible time, and with a complete utilization of the fuel. These objects are reached by the use of separate engines, one for the supply of air for the generation of the gas, and the other for its combustion. The details of a trial and illustrations of the furnace are given. The consumption of fuel, three hundredweight per hour for the two-ton furnace, is low. — (*Eng. min. journ.*, May 19.) R. H. R. [80]

GEOLOGY.

The mines of Cuba. — Salterain gives a brief account of the mines now worked, or that have been worked in the past, at least so far as known by the general inspection of mines. The 'minas de asfalto y de aceites (oils) bituminosos' are divided into mines of asphalt, of petroleum, and of naphtha, and number seventeen in all. The prospects are considered favorable, about eleven or thirteen hundred tons being produced annually. They are situated mostly in the provinces of Pinar del Rio, Matanzas, Santa Clara, Pto. Principe, and Habana. The copper-mines are thirty in number, almost all situated in the province of Santiago de Cuba, and a few in Santa Clara. The mineral consists of veins of sulphate of copper, oxide of copper, native copper, carbonate of copper, and indications of copper pyrites, all of which,

at a certain depth, are supposed to unite in one vein of sulphate of copper. The iron-mines, seventeen in number, are all situated in the province of Santiago de Cuba. The iron consists of large superficial masses of oligist and magnetic iron ore. Manganese is very abundant in the province of Santiago de Cuba, but only two mines have been registered on account of its small commercial value. There are five gold-mines situated in the provinces of Santiago de Cuba and Santa Clara, whose prospects are considered good, but which are not worked at present. Guano is worked in the islets south of Cuba, and 104 workmen were employed on this work last year. — (*Breve reseña miner. Isla de Cuba.*) J. B. M. [81]

The Prescott (Arizona) mining region. — A map of this region, with some account of the rocks and veins, has been published by John T. Blandy. The rocks appear to be mainly granites, argillites, and schists. The majority of the veins trend approximately north and south. In the stratified rocks many veins occur having the strike and dip of the enclosing rock, but they are of limited extent. In the Peck district the veins are of quartz, carrying silver in the form of chlorides, sulphides, and in galena. The argillite has been eroded away so that some of these veins stand as much as fifty feet high, while they are not more than six feet thick at the base. In the granite ridge next north, the veins are quartz and barite, carrying silver, while in the gneissoid rocks they are part silver and part gold bearing. The veins in the Mount Union granite are principally gold bearing, the gold being free on the surface, but in pyrite in depth. The chief portion of the remaining veins in the region are mixed gold and silver bearing, some being as much as thirty feet in thickness. Some veins of copper pyrites also occur. — (*Trans. Amer. inst. min. eng., Boston meeting.*) M. E. W. [82]

GEOGRAPHY.

Russian cartography. — M. Michel Venukoff presents frequent brief reports of Russian explorations and topographic work to the French geographical society, and has recently described the annual exhibition of astronomical and geographical works held last April in the Winter palace at St. Petersburg. The number of exhibits exceeded one hundred and forty, among which the more notable were a route-map of Russia in Europe (1:1,050,000), in twenty-five sheets, of which seventeen are finished; the latest sheets of the special maps of the same country (1:420,000), published under the direction of Gen. Strelbeitsky; the general map of Russia in Asia (1:4,200,000), in eight sheets, extending to lat. 30° N; maps of the provinces of Finland and Bessarabia; of the peninsula of Kamtchatka, prepared at Irkutsk; of the territory of Semipalatinsk, lithographed at Omsk; the Chinese and Persian frontiers (1:840,000); and many others of regions concerning which our chief knowledge comes from Russian surveys. — W. M. D. [83]

(*Arctic.*)

Notes. — Professor J. E. Nourse of Washington announces that he has in preparation a work relat-

ing to American polar expeditions. — The Russian imperial geographical society of St. Petersburg suggests that the observations of the international polar stations be prolonged over another year, on the ground that a single year's observations cover too short a time to afford really satisfactory comparative results; and, moreover, it will be necessary for some of the more advanced parties to make an end of their observations before the full year is out in order to be sure of returning during the present autumn. — Reports from Bering Sea indicate that the winter there has been a severe one. Early in the spring there was an abundance of ice as far south as St. Paul Island. Very few whales had been taken up to latest advices. — The report of the court of inquiry into the circumstances of the loss of the Jeannette and the death of members of the expedition is just printed. It does not contain the private journals of De Long and Collins, nor the papers of the latter which were before the court. The text of the report has been mostly summarized by the daily press, and contains nothing new of importance. It is presumed that the log-books, and records of observations, etc., are reserved for a report on the results of the voyage, to be hereafter issued. The most valuable thing in the whole document, which contains a number of maps and diagrams, is the map of the Lena delta constructed by Nindemann, which contains additions to and corrections of the maps in present use. — W. H. D. [84]

(*Asia.*)

Notes. — The *Revue géographique* presents its subscribers with a new chart of Asia on a scale 1:34,000,000. Although containing some new matter, it is not up to date, and is of very imperfect mechanical execution. — The Russian explorer Konchin telegraphs from Krasnovodsk, that, in crossing the steppe between Charzhui and Uzboi, he has discovered that Kalitin was mistaken in supposing it to be traversed by an ancient channel of the Oxus. What the latter explorer, three years ago, took for the dry bed of the Charzhui-Daria, is really only a plain bounded on the north by a series of elevations, and appearing to have no definite limits toward the south. — Potanin and Skassi are about to explore the Chinese province of Gan-su and the adjacent parts of Mongolia. Sukhacheff, a young proprietor of Siberian gold-mines, has contributed 20,000 rubles toward the expenses of the exploration. — The topographic and geodesic work in northern Khorassan and southern Turkestan being finished, the boundary-line between Russia and Persia from the Caspian to the Heri Rud River of Afghanistan will be established immediately. — The definite establishment of the boundary between the Russian province of Semipalatinsk and the Chinese district of Tsungari will also be concluded this summer. By recent conventions a considerable part of the basin of the upper Irtysh River is annexed to Russia. Topographers are busily engaged in determining its limits, while others continue the work of demarcation of the districts of Kuldja and Tarbagatai, which is already well advanced. Still others are developing the official limits

between the basins of the Syr Daria and the Tarim rivers. — W. H. D. [85]

Oxus and Caspian. — A recent report on the levellings undertaken by the Russian engineers to determine if the Oxus (Amu-daria) could be turned from its present channel, which leads to the sea of Aral into the Usboi channel, leading to the Caspian Sea, decides that it is impossible without extended artificial works. A canal would have to be constructed for a length of over two hundred versts, at a cost of at least fifteen to twenty million rubles, before it would be possible to divert the Oxus from its present course. — (*Peterm. geogr. mitth.*, 1883, 231.) W. M. D. [86]

(Africa.)

Notes. — Joseph Thompson's party has been heard from, having been obliged to retreat to Mombasa, on account of hostilities excited by a caravan in advance of them. All well, and would make another start with a different caravan. — Schweinfurth has made a scientific journey from Cairo to Mirsa Tobruk in Cyrenaica. — News has been received from the delayed Italian expedition to Abyssinia and the coast of the Red Sea, according to which the principal official party are detained at Debra Tabor by King John, while the explorer Antonelli has succeeded in getting away from Assab and in travelling through the Aussa country, previously closed to Europeans, to Schoa. — Dr. Pogge has returned to Mukenge, according to a letter forwarded by Portuguese traders from Malange, and will shortly depart for Europe. — The German traveller Flegel has returned to the coast from his journey in Adanaur. — The British government has annexed the territory lying south-east of the former limits of Sierra Leone as far as the Liberian boundary, between that and the Sherbro Islands. — Several French trading-stations have recently been established on the Futa Diallon coast, northward from Sierra Leone, in the hope of opening a lucrative traffic with the rich interior districts. — The French naval surgeon Colin has been intrusted with a mission to the old gold-country of Buré on the upper Senegal. — The Morocco authorities have permitted Spain to undertake a topographical investigation of the country around Santa Cruz de Mar Pequena, on the coast opposite the Canary Islands. — The khedive has appointed the minister of the interior and former governor of the Soudan, Eyoub Pacha, to the presidency of the Société de géographie de Cairo. The general secretary is Dr. Bonola. — The credits granted for the Algerian administration, by the commission to revise the estimates, amount to about twenty-eight and a half million francs, of which about three million francs are for purposes of colonization. The imports into the colony from all sources in 1880 were about eighty millions, and the exports about fifty-six millions. The customs receipts from all sources were about ten million francs. — Lieut. Angelo Cardozo of the Portuguese navy has just returned from Mosambique, where he has been eight months engaged in explorations in Sofala-land. He ascended last September from Inhambane toward Mulamula

and Pachano, along the mountains to Maringua, and across the Sabia River to Goanha; thence, descending the Gorongoza to Sofala, he returned to Inhambane by the seacoast. — Herr Beine has just been sent by the International African association to relieve Becker and replace M. Maluin, whose state of health requires an immediate return to Europe. — M. J. Lapeyre, second in command of the Giraud expedition, whose health had given way, was obliged to return from Aden to France on that account. — W. H. D. [87]

BOTANY.

Systematic histology. — By this term, Vesque designates the systematic classification of plants on the basis of histology. The variations of histological elements, as regards size, shape, and distribution, even in a single genus or species, are very wide, and, with limited exceptions, have not hitherto been regarded as very useful characters in classification. Vesque endeavors to show by an examination of the orders Capparidaceae, Cruciferae, and Frankeniaceae, that some histological characters are so nearly constant as to justify their employment in systematic botany. Such, for instance, are the stomata and hairs, the mucilage-cells, the palisade-cells, the shape and composition of the fibro-vascular bundles, etc. But, as was to be expected, the cases in which the histological characters are uncertain are so numerous as to be discouraging. That the species in many genera can be arranged in natural groups on the basis of their minute structure appears to be pretty clearly made out by Vesque's contributions. — (*Ann. sc. nat.*, Oct., vi. xv. 2.) G. L. G. [88]

Flowers of *Aesculus glabra*. — One of Prof. Coulter's students finds that the perfect flowers of the buckeye are protogynous, while others, which at first sight appear protandrous, really have imperfectly formed pistils. They are thus polygamous, with, it is thought, a tendency to monoicism. Bees, especially *Apis*, visit them, but go only to unopened buds, from which they obtain nectar by crowding their tongues between the petals. "The open flowers were avoided, and could only have been fertilized by the chance of being near the buds; for the bees had evidently learned that the latter contained the nectar. . . . It is a case of an insect attracted by a flower which it does not visit, but may accidentally fertilize, and obtaining nectar from a flower which it can neither fertilize nor obtain pollen from." The species is worthy of further study. — (*Bot. gazette*, June.) W. T. [89]

ZOOLOGY.

(General anatomy and physiology.)

Olfactory lobes of insects and vertebrates. — G. Bellonci, in continuation of his two previous articles (*Mem. accad. sc. Bologna*, 1880, and *Atti accad. reale lincei*, 1880-81) on the olfactory lobes of arthropods, now reports his further observations, which he has also extended to vertebrates. The same fundamental plan determines the structure and relations of the olfactory lobes in both the higher arthropods and the vertebrates. The olfactory and

commissural fibres of the lobes are resolved into a fine reticulum, which, grouped in certain spots, forms what Bellonci calls the olfactory glomeruli. The lobes of arthropods have an outer portion with a diffuse reticulum, and an inner portion with glomeruli. In vertebrates the ganglion-cells lie within the region of the glomeruli. In vertebrates and crustaceans there are numerous small, and fewer large, cells. In insects the elements are of small or medium size. In both arthropods and vertebrates the fibres establish both a direct and a cross (chiasma) communication between the olfactory and optic lobes; likewise between the olfactory lobes and the higher centres (reniform bodies of *Squilla*, fungiform of insects, and hemispheres of vertebrates). These resemblances the author attributes to an analogy of function, and not to a morphological homology between vertebrates and arthropods. The observations were made on *Squilla*, *Gryllotalpa*, the eel and frog. — (*Arch. ital. biol.*, iii. 191. A wrong title is given at the head of the pages.) C. S. M. [90]

Protozoa.

Action of tannin on *Paramecium*.—H. J. Waddington states, that, by bringing a drop of a solution of one part tannin in four parts glycerine in contact with a drop containing a *Paramecium*, the motion of the animal is stopped, and the cilia become beautifully distinct. They appear quite straight and surprisingly long, equal to the short diameter of the body. Previous ideas as to the size and number of the cilia have been very incorrect. To kill infusoria he recommends a saturated alcoholic solution of sulphurous acid; for, if a small quantity be added to water, the gas is set free, and the animals in the water poisoned. He also reports an ingenious device to catch infusoria: crumbs of very hard baked biscuit are put in the water, where they will be held up by confervae; fungoid growths spring from each crumb, the infusoria collect between the filaments as in a favorite resort, and the whole colony may be captured by pulling out the crumb. — (*Journ. roy. micr. soc. Lond.*, iii. 185.) C. S. M. [91]

Descriptions of rotifers.—To the eight species previously described of the genus *Floscularia*, C. T. Hudson now adds three, and gives also some notes on *F. regalis* Hudson. These four last-mentioned species are described and figured, and a synoptic table of all the species is added. In an appended note, the author comments on Leidy's *Acyclus* and *Dictyophora* (cf. SCIENCE, i. 37). He thinks *Acyclus* is related to the floscules. "Its 'oral cup' with the 'incurved beak' may be fairly said to be the buccal funnel of a floscule reduced to the possession of one lobe, viz., the dorsal one." The remainder is concerned with details, and with the degradation of certain rotifers, considered in connection with the absence of the trochal disk. — (*Journ. roy. micr. soc. Lond.*, iii. 161.) C. S. M. [92]

Worms.

Anatomy of Gephyreans.—Dr. C. Ph. Sluiter gives a preliminary notice of his observations on the anatomy of various species. An abstract will be

given of his definite memoir when published. — (*Zool. anz.*, vi. 222.) C. S. M. [93]

Annelid messmates with a coral.—J. W. Fewkes finds annelid tubes formed on the rim of young *Mycedium fragile*. As the coral grows, it spreads round the worm-tube; but the latter grows usually equally with coral. The presence of these tubes affects the regular growth of the coral. The species of worm does not appear to have been determined. — (*Amer. nat.*, xvii. 595.) C. S. M. [94]

Spermatogenesis of Nemertines.—In an article in the *Revue sc. nat.*, 1882, 165, Sabatier describes the development of the spermatozoa in nemertean worms. The parent cells separate into two parts, the central blastophore and peripheral bodies, which become independent, and attach themselves to the wall of the spermisac. From these bodies the spermatozoa arise by differentiation of the peripheral part into spherules, which elongate and become spermatozoa. In his theoretical conclusion, the author adopts the theory first advanced by Minot (*Biol. centralbl.*, 1882), that the ordinary cells are neuter, or combine both sexual elements, and that when a separation takes place the sexual products are generated. He makes an addition, however, to the theory, by the hypothesis that the central portion is female, the peripheral male. (There are many facts which appear at present irreconcilable with this view of the sexual relations within the cell.) — (*Journ. roy. micr. soc. Lond.*, April, 1883.) C. S. M. [95]

VERTEBRATES.

Action of alcohols on the heart.—The relative effects of different alcohols of the marsh-gas series of hydrocarbons upon the ventricle of the frog's heart have been compared experimentally by Ringer and Sainsbury. The method of experimenting was to place the heart in a Roy's tonometer, and feed it with the extract of dried bullock's blood until it was beating normally; the alcohol used was then added to the circulating liquid in such quantities, determined by previous experiments, as to completely arrest the contractions of the heart within an hour. The toxic action of the alcohols used was measured by the dose sufficient to arrest the activity of the heart. The following results were obtained. Normal methyl, ethyl, and propyl alcohol, — all three stop the heart in diastole, the ventricle losing its power to beat spontaneously, and refusing to respond to external stimulation. The excitability of the heart to electrical stimulation is diminished. The 'period of diminished excitability' is shortened. The primary effect of the alcohols on the heart is not, as might be supposed from their therapeutical use as cardiac stimulants, to increase the force or frequency of the ventricular contractions. The height of the curve given by the tonometer diminished steadily from the first application of the alcohol, and the frequency of the beats remained unaffected, except in the later stages, when the power of the heart to beat spontaneously was lost. With regard to the toxic action of the different alcohols, the following numbers are given (the figures represent the number of

minims of absolute alcohol in a hundred cubic centimetres of the circulating liquid, necessary to cause complete arrest of the heart): methyl, 205.5; ethyl, 114; propyl (primary), 59.3; isobutyl, 17; isoamyl (amyl alcohol of fermentation), 6.6. The activity of the higher members of the series increases rapidly; and as the propyl, butyl, and amyl alcohols are constituents of fusel oil, we have evidence of the directly injurious effect of this impurity of ordinary alcoholic drinks. — (*Practitioner*, xxx. v. 339.) W. H. H. [96]

Pulmonary epithelium. — Bozzoli and Graziadei publish a note chiefly to claim priority for certain of their observations on the lungs. We have only to notice that they have not seen any hyaline plates without nuclei in the epithelium, such as Feurstack has described. They also again insist upon the presence and pathological importance of groups of little cells, not yet differentiated into the special pulmonary epithelial cells (plates). — (*Arch. ital. biol.*, iii. 222.) C. S. M. [97]

Birds.

Molecular layer of the retina. — According to Bellonci, the formation of the inner molecular layer of the retina begins in the chick on the eighth day of incubation. At that time there is a special row of clear cells just outside the layer. The cells in the situation of the layer disappear on the ninth day: the clear cells undergo fatty degeneration of the nucleus, and disappear by the twelfth day. They form the molecular layer, which, however, continues to enlarge. Both the inner and outer molecular layer are penetrated by optic nerve-fibres. Thus is produced a structural relation with the molecular layers of the brain. — (*Arch. ital. biol.*, iii. 196.) C. S. M. [98]

The birds of Tonkak. — In this paper Herr Müller has given us an elaborate review of the birds of this island, based on a collection of sixteen hundred skins of one hundred and fifty-five species. The paper contains many systematic notes of interest. The author has prepared an extended set of tables from which he concludes that the Tonkak birds belong rather to the Indo-Chinese sub-region than to the Indo-Malayan as given by Wallace. — (*Journ. f. ornith.*, xxx. iv.) J. A. J. [99]

Mammals.

Development of the liver and lungs. — In connection with his researches on the development of the body-cavity Uskow made some observations on the liver and lungs of embryos. From the sinus venosus there grow out irregular cavities into the septum transversum, which extend into papillary growths, projecting into the pericardial cavity. The papillae are, of course, covered by a continuation of the epithelium of the pericardial cavity. They afterwards unite into a spongy mesh of tissue, into which the liver extends as it grows. The further history was not followed, but it is probable that the hollow outgrowths from the sinus venosus become hepatic vessels.

Concerning the lungs, from a study of a rabbit embryo of a little less than ten days, Uskow draws

the following conclusions. At the time of the closure of the 'vorderdarm,' the separation of oesophagus and trachea is already indicated. The lung is an unpaired evagination of the ventral wall of the 'vorderdarm.' The trachea and the lung arise at the same time, and independently; but the separation of the lung from the 'vorderdarm' precedes the separation of the trachea. The lung arises immediately in front of the liver; at the same time the cells of the mesoderm around the lung proliferate; and Uskow believes that the pleural (i.e., coelom) epithelium forms not only the pleural epithelium, but also the deeper-lying mesodermic elements (muscles, etc.) of the lung. — (*Arch. mikr. anat.*, xxii. 219.) C. S. M. [100]

A hybrid between the gayal and zebu. — Dr. Julius Kühn announces the birth, at the agricultural institute of the Halle university, of a hybrid between the gayal of eastern India and the long-horned race of zebras known as sangas, which was held in domestication by the ancient Egyptians, and is now abundant in Soudan and Abyssinia. The hybrid in question is a female; it weighed, at birth, 21.5 kilograms, or about one-twentieth the weight of the sanga mother. The latter is of a mottled red and white color, while the calf is of a clear red brown, only the belly and inner sides of the legs and the fetlocks being white. The hump on the withers, so characteristic of the zebu, is only slightly developed. "In the birth of this animal it is shown that animals of the most primitive forms, which for thousands of years have had unchanged surroundings, by suitable treatment, may remain unimpaired in fertility, even when placed in relations which are in the greatest degree different from those of their native home." — (*Zool. garten*, xxiv. 1883, 126.) F. W. T. [101]

ANTHROPOLOGY.

Origin of the Magyars. — Mr. Herman Vambery published a work in Leipzig last year, in which he takes the ground that the Hungarians are of Turkish and not of Finno-Ugrian origin, as is believed by most ethnologists, and especially by M. Hunfalvy. A census of the Turco-Tatar stock is given, which may be of service to some of our readers.

Turco-Siberians	141,992
Eastern Turkestan	1,040,000
Kirghiz	2,299,366
Kara-Kirghiz	350,000
Turcomans	1,000,000
Kara-Kalpaks	70,000
Usbegs	2,500,000
Kipchaks	70,000
Kuramans	77,301
Sarts	900,000
Bushirs	500,000
Tatars	638,710
Nogajs	200,000
Kuvaks [?]	600,000
Kalmuks	71,000
Transcaucasian Turks	900,000
Iranic Turks	200,000
Osmanli	10,000,000
	21,558,369

— (*Archiv. per l'anthrop.*, xii. 297.) J. W. P. [102]

Macrobiotia. — The narrative of Genesis about the long lives of the patriarchs has very frequently

led to the collation of the ages of persons who have lived to a very great age. Lord Malahide is inclined to give credit to the great number of cases of recorded longevity occurring among the inscriptions recovered from old Roman graves in Algeria and Tunisia. Mr. Renier has published a collection of these, and a still more complete series is by Mr. Willman, under the auspices of the Royal academy of Berlin. Upwards of ten thousand inscriptions are thus calendared.

The following is a list from Numidia:—

101	14 persons.	110	5 persons.
101	10 "	115	4 "
102	2 "	120	3 "
103	1 person.	125	2 "
105	7 persons.	126	1 person.
106	1 person.	127	1 "
107	1 "	131	1 "
108	1 "	132	1 "

At Mastar, a small town, the cemetery yields the following:—

Anna R.	101	Marcela	120
Cocilius	100	Januarius	101
Gargilius	103	Martialis	105
Granius	110	Another	115
Ninava	115	Jussata	105
Petrea	115		

Lord Malahide, in order to show the credibility of these figures, speaks at length upon the duties of the Roman censors. — (*Journ. anthropol. inst.*, xii. 441.) J. W. P. [103]

The Pawnees.—Mr. John B. Dunbar of Bloomfield, N.Y., has brought together in a quarto pam-

phlet his researches into the Páni family of North American Indians. The tribes embraced in this group are the Pawnees, Arikaras, Caddos, Huecos or Wacos, Keechies, Tawaconies, and Pawnee Picts or Wichitas. The last five are the southern or Red River branches. A brief account of each of these is given in the first few pages of the pamphlet. The third paragraph is devoted to the Arikaras, and the remainder of the monograph to the Páni, or Pawnees. A very extensive bibliography of the stock has been collected, commencing with the expedition of Lewis and Clarke, and including the publications of Pike, Long, J. T. Irving, Murray, Hayden, and the reports of the several commissioners of Indian affairs. Earlier notices are found in la Harpe, du Pratz, and Charlevoix.

The name 'Pawnee' is probably derived from *Párik-í* (a horn), referring to their peculiar scalp-lock. The original hunting-ground extended from the Niobrara, south to the Arkansas, but no definite boundaries can be fixed.

Mr. Dunbar has collected from various sources the traditions of their origin and migrations (§ 8), their conflicts (§ 9), their census (§ 10), and their later history since the beginning of our century. Considerable space is given to their tribal organization, physical characteristics, social usages, dress, names, lodges, arts, trade, feasts, hunting, war, medicine, mourning, religion, calendar, present condition and prospects. Brief chapters are devoted to the celebrated chiefs, Pitale-sharu, Lone Chief, and Medicine Bull. — J. W. P. [104]

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

STATE INSTITUTIONS.

State university of Kansas, Lawrence.

Weather report for June. — The chief meteorological features of this month were the low mean temperature and the abundant rainfall. During the fifteen preceding years, three Junes have been cooler than this, and only one (1876) has had a larger rainfall.

Mean temperature, 71.38°, which is 2.87° below the June average. The highest temperature was 94°, on the 22d and 30th. The mercury reached or exceeded 90° on only six days. The lowest temperature was 48.5°, giving a range of 45.5° for the month. Mean temperature at 7 A.M., 66.22°; at 2 P.M., 80.3°; at 9 P.M., 69.5°.

☾ Rainfall, 7.73 inches, which is 2.80 inches above the June average. There were seven thunder-showers, one of which, on the night of the 11th, continued for six hours, and brought 2.92 inches of rain. The entire rainfall for the six months of 1883 now completed has been 21.80 inches, which is 5.05 inches above the average for the first half-year of the past fifteen years.

Mean cloudiness, 38.56% of the sky, the month being 3.64% clearer than the average. Number of

clear days (less than one-third cloudy), 14; half clear (from one to two thirds cloudy), 12; cloudy (more than two-thirds), 4. There were four entirely clear days, and only one entirely cloudy day. Mean at 7 A.M., 42.67%; at 2 P.M., 39.33%; at 9 P.M., 33.67%.

Wind: S.W., 24 times; S.E., 24 times; N.W., 17 times; N.E., 14 times; N., 4 times; S., 4 times; E., 3 times. The entire distance travelled by the wind was 10,737 miles, which is just two miles above the June average. This gives a mean daily velocity of 357.90 miles, and a mean hourly velocity of 14.91 miles. The highest velocity was 45 miles an hour, on the 22d and 23d. The thunder-storm of the 11th was ushered in at 11.30 P.M. by a very strong 'straight' wind, which unroofed a portion of the Central school building at Lawrence, but was in no sense a tornado.

Mean height of barometer, 29.028 inches; at 7 A.M., 29.050 inches; at 2 P.M., 29.013 inches; at 9 P.M., 29.020 inches; maximum, 29.217 inches, on 14th; minimum, 28.671 inches; monthly range, only 0.546 inch.

Relative humidity: mean for month, 74.3; at 7 A.M., 83.1; at 2 P.M., 57.7; at 9 P.M., 82.1; greatest, 97, on 23d and 24th; least, 37, on 14th.

PUBLIC AND PRIVATE INSTITUTIONS.

Ohio Wesleyan university, Delaware, O.

Additions to the museum. — The increase to the collections for the year amounts to 9,202 specimens. The aim of the curator is not to build up a great museum, but one of great educational value, which shall in time contain every specimen needed to explain the facts of natural history as presented in the text-books of the department. All purchases and solicited exchanges are for this end, and even the volunteer exchanges are turned in this direction as far as practicable. W. F. Falconer has given an extensive collection made at the phosphate beds of Charleston, S.C. An elephant's tooth in this collection measures ten by fourteen inches, and weighs twenty-nine pounds.

Prof. R. E. Call of Nebraska, a most enthusiastic naturalist, spent the summer of 1882 on a collecting trip through Georgia. The museum joined with other institutions in defraying his expenses, and sharing the results. Although all the material has not been distributed, over five thousand specimens have been received, and a large number of new and valuable species.

The U. S. fish-commission has presented a collection illustrating the marine fauna of the New England coast. It contains nearly one hundred species, many of which were obtained by dredging at depths as great as two hundred fathoms.

Collections of importance have also been received from the late Mr. C. R. McClellan, a former assistant, and from Revs. J. M. Barker of Mexico, and H. Mansell of India, and the Brothers Willis, recently returned from a tour of the world.

The shelves in all the cases are overcrowded; and at least twenty-five thousand specimens are packed away in boxes and drawers, awaiting study, and room in which to display them. The erection of one or more new cases is required.

NOTES AND NEWS.

The summer courses of instruction in chemistry, offered to teachers by Harvard university, opened July 6, in the chemical laboratories of Boylston hall, and will continue six weeks. The course in general and descriptive chemistry is taken by twelve persons, the course in qualitative analysis by ten, and quantitative analysis by five. There are also eight persons who are engaged on advanced quantitative analysis, organic chemistry, and original research. Lectures are given twice a week on general chemistry, daily on qualitative analysis, and twice a week on quantitative analysis. The laboratories are open daily from 8 A.M. to 6 P.M. The following states are represented: Maine, Massachusetts, New York, New Jersey, Ohio, Illinois, Michigan, Minnesota, Nebraska, and Georgia. Of the thirty-five persons mentioned above, five are women, and eight are continuing their work from former courses. As in previous years, these courses are under the direction of Dr. C. F. Mabery.

— Upon the death of Charles Darwin, last year, the advocates of evolution in the Paris anthropological society organized a *Conférence annuelle transformiste*, in which one of their number who is a specialist shall set forth the manner in which the doctrine of transformism has affected his department of research, and also the arguments which his studies have furnished for the substantiation of the doctrine. The opening lecture of the course was delivered by M. Mathias Duval, upon the mutual relations of evolution and the embryology of the eye, and is published in the *Revue scientifique* for May 12. The first part of the discussion is an attack upon the doctrine of special creation and final causes. It does not seem to have come to the notice of our French colleagues, that the doctrine of special creation, like all other doctrines (evolution, for instance), has modified itself from time to time by the increase of knowledge. "These admirable appropriations of an organ to an end," says M. Duval, "are explained by the gradual perfecting of a mechanism, which, setting forth from simple and elementary adjustments, develops, by heredity and selection, the forms that are more and more advantageous to the individual. Upon the question whether embryology confirms this theory, it is proposed to examine the successive forms which the eye presents in the animal series, and the successive stages of its development in man or the higher vertebrates. In other words, the phylogeny will first be questioned, and afterward the ontogeny, of the *globe oculaire*, to see whether these two series of facts are a repetition the one of the other." Briefly passing over the unicellular forms, and those in which the eye is undifferentiated, the author commences his more special investigation with the tunicates and amphioxus, from which point the argument is conducted with great precision, and is well illustrated.

— The French academy of sciences proposed as a subject for one of its 1882 prizes the following: "To find the origin of the electricity of the atmosphere, and the causes of the great development of electrical phenomena in storm-clouds." Several memoirs were received by the academy; but no one of them was adjudged worthy of the prize, although a reward and encouragement of a thousand francs was granted to one of the competitors. The academy, therefore, continues the above as one of the prize subjects for 1885. Memoirs will be received up to June 1, 1885. Each must be accompanied by a sealed envelope containing the name and address of the author. The envelope will not be opened unless the memoir is successful. The value of the prize is three thousand francs.

— The sixth annual convention of American librarians will be held in Buffalo, Aug. 14 to 17. The opening address will be delivered by the president, Justin Winsor. Excursions will be made down the Niagara River, and, at the close of the session, to Niagara Falls. Further details may be obtained from Mr. John N. Larned, Young men's library, Buffalo.

— The Smithsonian institution will soon publish

Professor Bolton's Catalogue of scientific and technical periodicals. Proof-sheets have been sent to the leading libraries of the country, with the request that it should be noted what journals might be on their shelves; so that we shall have a complete list of available scientific periodicals.

—The Johns Hopkins university circular for June is given up to a statement of the work of the past year, and a programme of the courses offered for the year 1883-84.

—According to *Nature*, the emperor of Austria, on June 5, inaugurated the new Vienna observatory on the Turken Schanze, in the northern outskirts of the town. The new building has taken nine years to construct; and during that time the present director has travelled all over Europe and America in order to study the construction and equipment of the best observatories. The result is, that the Vienna observatory is probably one of the most complete in existence.

—Dr. Ph. Paulitschke's work on the '*Geographische erforschung des afrikanischen continents*' (Vienna, 1880), in which he gave a brief statement of the work of all explorers from ancient times down to the date of publication, is now supplemented by his '*Afrika-literatur in der zeit von 1500 bis 1750 n. Chr.*' (Vienna, 1882),—a work of 122 pages, with 1,212 titles. Valuable cartographic aid to study in the same direction is given in H. Kiepert's maps of the progress of African exploration from 1750 to 1873, and of the expeditions of this century, colored according to their nationality; these being published in the journal of the Berlin geographical society in 1873 and 1874, and again in the ten larger scale charts of inner Africa by Petermann and Hasenstein, issued as a supplement to the *Mittheilungen* in 1863.

—Mr. W. G. Black is preparing the index for his Folk-medicine, already in print, and to be issued immediately by the Folk-lore society. The work treats of the origin and communication of disease, and the influence in folk-medicine of charms, saints, and heavenly bodies.

The same society hopes soon to obtain for publication a collection of Zulu nursery literature, which has been in the hands of Bishop Callaway for ten years. This will be an addition to folk-lore of very great interest and value.

RECENT BOOKS AND PAMPHLETS.

Adrian, T. Ueber projectivitäts- und dualitäts-beziehungen im gebiete mehrfach unendlicher kegelschnittschaaren. Berlin, 1882. 54 p. 8°.

Ambühl, G. Anleitung zur milchprüfung. St. Gallen, Huber, 1883. 43 p. 8°.

Amunátegui, M. L. El terremoto del 13 mayo de 1647. Santiago de Chile, 1883. 620 p. 4°.

Ballard, H. H. Hand-book of the St. Nicholas Agassiz association. Pittsfield, *Axtell & Pomeroy, pr.*, 1882. 5+85 p. 24°.

Barron, A. F. Vines and vine-culture: being a treatise on the cultivation of the grape-vine, with description of the principal varieties. London, 1883. 240 p., illustr. 8°.

Bastian, A. Volkerstämme am Brahmaputra und verwandtschaftliche nachbarn. Berlin, *Dümmers*, 1883. 70+130 p., 2 col. pl. 8°.

Béchamps. Les microzymas dans leurs rapports avec l'hétérogénie, l'histogénie, la physiologie et la pathologie. Paris, 1883. 8°.

Behrend, G. Eis- und kälteerzeugungs-maschinen, nebst einer anzahl ausgeführter anlagen zur erzeugung von eis, abkühlung von flüssigkeiten und räumen. Halle, 1883. 8°.

Bersch, J. Die verwerthung des holzes auf chemischem wege. Die fabrikation von oxalsäure, alkohol und cellulose, der gerbstoff- und farbstoff-extracte aus rinden und hölzern, der ätherischen oele und harze. Wien, 1883. 368 p., illustr. 8°.

Bleunard, A. Le mouvement et la matière. Lectures sur la physique et la chimie. Paris, 1883. 374 p., illustr. 8°.

Branco, W., und Reiss, W. Ueber eine fossile säugethier-fauna von Punin bei Riobamba in Ecuador. Mit geologischer einleitung. Berlin, 1883. 166 p. gr. 4°.

Brown, J. E. The forest flora of South Australia. part i. London, 1883. pl. f°.

Buccola, G. La legge del tempo nei fenomeni del pensiero; saggio di psicologia sperimentale. Milano, *Dunolard*, 1883. *Bibl. intern.* 15+432 p. 8°.

Buckland, F. Log-book of a fisherman and zoölogist. New edit. London, 1883. 352 p., illustr. 8°.

Candolle, A. de. L'origine delle piante coltivate. Milano, 1883. 644 p. 8°.

Cantor, G. Grundlagen einer allgemeinen mannigfaltigkeitslehre, mathematisch-philosophischer versuch in der lehre des unendlichen. Leipzig, *Teubner*, 1883. 51 p. 8°.

Cerón, S. Estudio sobre los materiales y efectos usados en la marina. Cádiz, 1883. 652 p., illustr. 4°.

Congresso geografico internazionale terzo tenuto a Venezia dal 15 al 22 settembre, 1881. vol. i. Notizie e rendiconti. Roma, *Soc. geogr. ital.*, 1882. 404 p., pl. 8°.

Cotteau, Peron, & Gauthier. Échinides fossiles de l'Algérie. fasc. i. Terrains jurassiques. Paris, 1883. 79 p., illustr. 8°.

Credner, H. Geologische profile durch den boden der stadt Leipzig und deren nächster umgebung. Leipzig, *Hinrichs*, 1883. 5+71 p., pl. f°.

Dawidowsky, F. Fabrication of glue, gelatine, cements, pastes, mucilages, etc. Translated from the German, with additions, by W. T. Braunt. Philadelphia, 1883. 275 p. 12°.

Dodel-Port, A. Illustriertes pflanzenleben. Gemeinverständliche originalabhandlungen über die interessantesten und wichtigsten fragen der pflanzenkunde. Zürich, 1883. 490 p., illustr. 8°.

Faà di Bruno, F. Théorie des formes binaires. Turin, 1883. illustr. 8°.

Faber, G. L. The fisheries of the Adriatic and the fish thereof, with a systematic list of the Adriatic fauna. Preceded by an introduction by Günther. London, 1883. illustr. 4°.

Falkenburg, C. Neue schieberdiagramme und neue theorie der dampfvertheilung in anwendung auf die steuerung der stationären und locomotorischen dampfmaschinen. Leipzig, 1883. 8°.

Faramelli, T. Descrizione geologica della provincia di Pavia, con annessa carta geologica a colori nella scala di 1 per 200,000. Milano, 1882. 104 p. 4°.

Graetz, L. Die elektricität und ihre anwendungen zur beleuchtung, kraftübertragung, metallurgie, telephonie, und theographie. Stuttgart, 1883. illustr. 8°.

Gross, V. Les Protohelvètes ou les premiers colons sur les bords des lacs de Bienne et Neuchâtel. Avec préface de Virchow. Berlin, 1883. 120 p., illustr. 4°.

Halphen. Mémoire sur la réduction des équations différentielles linéaires aux formes intégrales. Paris, 1883. 301 p. 4°.

Harting, J. E. Sketches of bird life from 20 years' observations of their haunts and habits. London, 1883. 302 p., illustr. 8°.

Heen, M. P. de. De la dilatabilité de quelques liquides organiques et des solutions salines. Bruxelles, 1883. 51 p., illustr. 8°.

Helderich, T. de. Flore de l'île de Céphalonne ou catalogue des plantes, qui croissent naturellement et se cultivent le plus fréquemment dans cette île. Lausanne, *Beidel*, 1883. 90 p. 8°.

Helldriegel, H. Beiträge zu den naturwissenschaftlichen grundlagen des ackerbaues. Braunschweig, 1883. 8°.

Herbert, D., edit. Selection from the prize essays of the International fisheries exhibition, Edinburgh, 1882. New York, 1883. illustr. 8°.

Hofmann, E. Der käfersammler. Stuttgart, 1883. illustr. 8°.